OLD BRIDGES
OF FRANCE

William L. MacDonald
May 1970
from Francesca Wiig

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Old Bridges of France

Let us respect our old bridges : some of them have been ruined by being widened. It is an evil deed to destroy a monument, the fruit of the labors of our fathers. It belittles us. We should respect those monuments that have endured through the ages, especially in our own land. Let us be faithful to the Past, which is the foundation of the Present and the guarantee of the Future. Let us protect from the vandals our old bridges, our old churches, all of our old France. Præteriti fides spes futuri.

(P. Séjourné)

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OLD BRIDGES OF FRANCE

PREFACE BY

M. VICTOR LALOUX

MEMBRE DE L'INSTITUT

A SERIES OF HISTORICAL EXAMPLES FROM ROMAN TIMES TO THE END OF THE XVIIITH CENTURY.

WITH AN EXPLANATORY AND DESCRIPTIVE TEXT,
24 REPRODUCTIONS IN COLOR FROM THE ORIGINAL WATERCOLORS BY
PIERRE VIGNAL,
35 BLACK AND WHITE DRAWINGS BY
LOUIS C. ROSENBERG & SAMUEL CHAMBERLAIN,
44 MEASURED DRAWINGS, PHOTOGRAPHS, DIAGRAMS AND MAPS.

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THE OLD BRIDGE AT ALBI

PRÉFACE

Mes Chers Amis,

Vous ne sauriez évidemment mettre en doute le plaisir que je puis avoir à présenter au public un ouvrage dû à la collaboration de deux de mes anciens élèves. Vous ne doutez pas davantage, je suppose, que ce plaisir soit d'une qualité particulière si l'ouvrage dont il s'agit aborde une question vraiment intéressante, et si la façon dont il est présenté et traité l'impose d'emblée à notre attention.

Il semble bien que l'abondant recueil de relevés, de notes, d'aquarelles et de dessins que vous consacrez aujourd'hui aux vieux ponts de la France possède en plus une qualité fort appréciable : celle de combler une lacune, assez surprenante en vérité mais très réelle, puisque les architectes, qui nous ont donné tant de monographies remarquables, se sont un peu désintéressés des ponts; il n'est pas mauvais que deux de nos confrères se soient plu à réunir pour nous une si riche collection de documents et à nous rappeler ainsi combien la noblesse des lignes de quelques-uns des grands ouvrages qu'ils nous présentent peut ajouter de dignité à certaines perspectives, comme celle de la pointe du Vert-Galant, ou de réelle beauté à un paysage comme celui de la vallée du Gard, quand on la voit barrée, au-dessus de Remoulins, par la masse formidable du vieil aqueduc romain.

Ce n'est pas, on le conçoit sans peine, qu'on manque d'ouvrages purement techniques sur la question. Des traités extrêmement complets sur la construction des ponts ont été publiés par des ingénieurs distingués. On retrouve constam-

ment, au cours de votre texte, les noms de MM. Morandière et Séjourné — et plus souvent encore celui de M. de Dartein, dont le recueil si complet sur les ponts en pierre fait incontestablement autorité. Mais bien que cet ouvrage ait été conçu avec une belle largeur d'esprit, bien que l'auteur se soit volontairement limité à l'étude des ponts "remarquables par leur décoration", il s'agit cependant, là encore, d'un livre qui vise plus à compléter l'éducation des ingénieurs, à éveiller chez eux la notion du sentiment esthétique, — qu'à intéresser les architectes et les simples amateurs en leur montrant, sous une forme attrayante, des compositions où ils seront surpris de rencontrer parfois un tel souci et une telle impression de beauté là où, peut-être, au premier abord, ils n'imaginaient trouver que la solution toute sèche d'un problème de résistance des matériaux.

Il n'y a pas là, si nous voulons y songer, de quoi nous surprendre grandement. Ce qui, de près ou de loin, se rattache à l'architecture n'en est-il pas toujours un peu là? Est-il un seul problème constructif que le talent de l'artiste ne puisse à un moment donné, élargir et embellir au point de nous émouvoir profondément ? On ne saurait s'en convaincre mieux qu'en feuilletant cette série d'aquarelles charmantes qui donnent une telle saveur à votre recueil et où le talent d'un Vignal a fixé si plaisamment des aspects si divers de notre pays, ou qu'en examinant avec l'intérêt qu'ils méritent ces prodigieux crayons de M. Rosenberg et de M. Chamberlain, spirituels et expressifs jusqu'à la dernière hachure, où l'architecture s'affirme et se précise avec une si incroyable simplicité de moyens.

Le texte et les géométraux, qui constituent la substance de l'ouvrage et qui sont votre part à vous, me paraissent constituer un ensemble de renseignements amplement suffisant pour documenter tous ceux qui sont susceptibles de s'intéresser aux ponts, sans vouloir aborder pour cela l'étude de la stabilité des voûtes et le côté purement technique de leur construction. Les notes historiques et descriptives nous apprennent ce que nous désirons savoir, sans que le point qui nous intéresse y disparaisse (comme il arrive si souvent) sous une accumulation de données fastidieuses : écrit par deux architectes, votre livre s'adresse d'abord à nos confrères; mais on y sent aussi la préoccupation constante de dévoiler aux amateurs, et sans doute aussi aux touristes étrangers et français, des beautés qu'ils ne s'aviseraient peut-être pas de découvrir dans des villes de second ordre, situées à l'écart des grands chemins. Si votre ouvrage peut engager quelques artistes à visiter des villes telles que Cahors ou qu'Albi, ou à parcourir les régions du Languedoc et de la Provence où vous signalez tant de ponts intéressants, sans doute n'aurez-vous perdu déjà ni votre temps ni votre peine et l'un des buts que vous pouviez vous proposer se trouvera-t-il pleinement atteint.

Il vous est permis d'ailleurs d'espérer mieux. Car, imposants ou modestes, la plupart des monuments dont vous nous entretenez ont pour nous la valeur d'un enseignement précieux : la conscience, le talent et le goût dont un homme comme le bourguignon Gauthey a su témoigner dans l'exécution de simples ponceaux (ceux par exemple que vous nous signalez dans la banlieue d'Auxerre et de Châlon) montrent, mieux que tous les raisonnements théoriques, que le caractère purement utilitaire d'un programme n'impose nullement au constructeur l'indifférence ou la vulgarité. C'est là une vérité que vous et moi, mes chers amis, nous ne sommes pas les seuls à connaître — fort heureusement — mais qu'il n'est pas mauvais de mettre en évidence de temps à autre par des publications comme celle-ci, à une époque aussi hésitante que la nôtre où trop constamment le vrai et l'utile, du fait des nécessités matérielles, semblent prendre le pas sur le Beau. (1)

V. LALOUX.

Paris, 1er décembre 1924.

(1) My dear Friends,

You certainly can have no doubt of the pleasure that I take in presenting to the public a work which it owes to the collaboration of two of my former pupils. Neither can you doubt that this pleasure is the greater since the work in question treats a subject of genuine interest, presented and handled in such a manner as to at once arrest one's attention. It seems indeed that the abundant accumulation of extracts, of notes, of watercolors and of sketches that you devote to the old bridges of France possesses besides a very particular quality, namely that of filling a gap, — a rather surprising, but very real one. Inasmuch as the architects, who have given us so many remarkable monographs, have taken no special interest in bridges, it is well that two of our confrères have been pleased to gather for us so rich a collection of documents, and to remind us in this way how the noble lines of some of the great works which they present add to the dignity of certain views, such as the point of the *Vert-Galant*, or to the beauty of certain landscapes such as that of the Valley of the Gard seen from above Remoulins, crossed by the formidable mass of the old Roman aqueduct.

Technical works on the subject of bridges are of course not lacking; in fact, extremely complete treatises on their construction have been published by distinguished engineers. In the course of your text the names of Messrs. Morandière and Sejourné constantly appear, and still oftener that of Mr. de Dartein whose conscientious study of stone bridges is positively authoritative. But though this work has been conceived in a fine, broad spirit, and though the author has chosen to limit himself to the study of bridges " remarkable for their decoration ", we have in your book one which may serve to complete the education of engineers, to arouse in them the idea of aesthetic feeling even more than to inspire architects, or to interest mere amateurs by showing them, under an attractive form, compositions in which they will be surprised to find the expression of beauty when perhaps, at first sight, they had expected only the dry solution of the problems of resistance of materials.

Perhaps is there nothing surprising in this : for does not the very essence of architecture, whether we are intimately or only generally acquainted with it, lie in this haunting quality of beauty ? Is there a single constructive problem that the talent of the designer cannot, at a given moment, develop and embellish to the point of profoundly moving us ? No more convincing evidence of this could be found than in turning the leaves of this series of charming watercolors which impart such zest to your collection, where the talent of a Vignal has so pleasingly recorded the many aspects of our country; or in examining with the interest they merit the amazing sketches of Mr. Rosenberg and Mr. Chamberlain, sensitive and expressive to the last stroke of the architecture which they interpret in such an astonishingly simple manner.

The text and the geometrical drawings which constitute the substance of the work, and which are your special contribution, appear to me an amply sufficient assemblage of information to direct those who are alive to the interest of bridges, but who do not care to enter upon a study of the stability of vaults or of the purely technical side of their construction.

The historical and descriptive notes tell us what we desire to know, without allowing the point which interests us to be lost (as so often happens) under an accumulation of tiresome details. Written as it is by two architects, your book appeals at once to our confrères; but one feels also its constant intention to reveal to the amateur and, doubtless, also to the traveler, whether foreign or French, beauties which, being hidden in the smaller towns far from the more travelled roads, would otherwise escape him.

If your work does no more than persuade some artists to visit towns like Cahors or Albi, or to roam through the regions of Languedoc and Provence, where you note so many bridges of interest, you will doubtless feel that neither your time nor trouble was wasted, and that at least one of the objects you may have had in mind is fully attained.

You may allow yourselves a still further hope, for the greater part of the monuments, whether imposing or modest, which you describe, has for us architects the value of a precious instruction. The conscience, talent and taste which a man like the Burgundian Gauthey has brought to the solution of the most elementary bridge-problems such, for example, as those you mention in the suburbs of Auxerre and of Châlon, show better than any mere theorizings that the purely utilitarian character of a programme imposes upon the constructor neither indifference nor vulgarity. This is a truth that you and I, my dear friends, are most fortunately not the only ones to recognize, but which it is well to bring to light from time to time by such a publication as this, particularly at so uncertain a time as ours, when all too frequently hard facts and mere utility, owing to the pressure of material needs, seem to take precedence of pure beauty.

V. L.



THE BRIDGE AT SOSPEL

INTRODUCTION

A just appreciation of these old bridges of France depends upon a recognition of the personality or individuality of each structure, aside from the particular character that each builder gave to his design. Just as the faces of those whom we love have been affected by the experiences through which they have passed, so have the history, surroundings, materials and the very nature of the rivers that they span, combined to express in the battered piers, well worn road-beds, and much repaired arches of these bridges, the same qualities that one learns to read in the lines and features of well known faces.

These bridges remain one of the great, if little known, glories of a country which is already famous for its wealth of other architectural material. Modern traffic requirements, both as to quantity and quality, have combined with the staggering burdens that the Great War imposed on the national government, to make the maintenance of these old masterpieces a serious problem from the point of view of practicability as well as from that of art. That they should be perpetuated at least in drawings is the purpose of the authors, believing them to be of sufficient interest to appeal to many who are without the professional training of architects or engineers, to whom the following comments are particularly addressed.

The bridge, as a problem in design, would seem at first glance to offer little opportunity for either great variety or great originality. Even a cursory investigation, however, shows us that few subjects with such simple elements offer so wide a variety of solutions, or so fine an opportunity to study composition at a truly monumental scale.

The masonry bridge is essentially an architectural problem. More is the pity, therefore, that so few architects take an active interest in what constitutes so tempting an opportunity. But if, alas, they are not designing bridges, they can at least appreciate the graceful curve and vigorous silhouette of these soaring arches, which seem, in many instances, to be the very spirit of the towns in which they dwell. They can also recognize that bridge and river alike combine with the town to emphasize its importance, and add to its

beauty. What would Venice be without its *Canale* and its Rialto, or Florence without the turbid Arno, the *Ponte Vecchio* and the handsome Ammanati bridge? Rome, indeed, would not be Rome without the venerable Tiber spanned by its fine old bridges.

France makes no claim to bridges of such singular renown, but she may justly take pride in a considerable number that are of unusual interest. These show great diversity in both style and design ; they are the product of twenty centuries of history, and among them are some that may be considered the very finest of their kind. For instance, while Italy has a wealth of fine old aqueducts, she has nothing that compares, in our opinion, with the glorious arches of the Pont du Gard. The fortified bridge at Verona, impressive though it is in mass and color, must yield to the really classic charm and rare simplicity of the bridge at Cahors. The French Renaissance produced somewhat less remarkable structures; in fact, it was not until nearly two hundred years later that anything comparable with the progress shown in the bridge of the Trinity at Florence appeared in France. Nevertheless, a series of bridges was built in the seventeenth and eighteenth centuries that perfectly expressed the characteristic architectural features of this brilliant period; and there can be no doubt that the bridges of Gauthey and Perronet in this period would have been worthy of high praise at any time in the history of art. In fact these two great builders belonged to that group of scientists that later produced Léonce Reynaud, and in our own time M. de Dartein, men whose familiarity with mathematics seems to have only enhanced their appreciation of beauty, and who personified to a high degree that nice balance of qualities so characteristic of the French scientist. These qualities are expressed in one instance by a work, of particular interest in these days of reinforced concrete, devoted to those bridges "that are distinguished by their decoration;" and, in the other, by a treatise on architecture which, in spite of changing fashions, remains one of the best that has yet been written.

Practical necessities, aside from any consideration of beauty, are even more exacting in bridge building than in other architectural problems. Indeed, it is often in the satisfying of these tyrannical requirements that we find the very essence of our problem : in truly meeting the pratical we thus discover the beautiful. We recognise that, as civilization became more complex, the bridge gradually ceased to be merely a means of carrying a road from bank to bank. It became rather the means by which two traffic currents should cross one another, one by the roadway above, the other by the river beneath. It is the total opening for the latter, the free-way, that remains in most instances the controlling element of the problem, the element to which all

others are subsidiary. If this free-way is inadequate the bridge becomes an obstruction : at the first flood the waters, finding insufficient exit, overflow the banks; the current will at the same time become so rapid that navigation is dangerous. If, on the other hand, the free-way is excessive, other incon-



THE BRIDGE AT SOSPEL
FROM THE PENCIL SKETCH BY LOUIS C. ROSENBERG.

veniences result : arches of wider span are both difficult and expensive to build; and an excessive free-way means a sluggish current which, in turn, results in a shallower river-bed because of the resulting deposits [1].

From this angle, our quondam simple problem begins to look complicated. But an exact knowledge of the maximum volume of water at flood, together with a correct gauge of the swiftness of the current, will enable us to determine the required free-way, and thus decide the number of piers and arches that should compose the bridge. Judged from the point of view of navigation alone, the fewer piers the better, but, as stated above, both cost and difficulty of execution enter into the question; for the fewer the piers, the larger the arches, and correspondingly the higher the roadway of the bridge above the level of the river. This latter question is again affected by

(1) The reader is referred to Léonce Raynaud. (*Traité d'Architecture*, 2d Vol., 3d Part.).

the height of the banks. As extreme examples of alternative possibilities, compare the bridge at Céret, its road-way 30 meters above the stream, with that at Airvault where it is only six.

This same question of the free-way is one of the determining considerations in the choice of the curve for the arches. We may well agree that in most instances the semicircular arch gives us not only the simplest but also the most agreeable solution. Indeed, even though the arches of the bridge of Ammanati, to which we have already referred, are very much flattened, and though there are undoubtedly many other handsome structures where either the pointed or the three-centered arch is employed to advantage, still those that utilize the semicircle thereby attain with the least effort a monumental quality that the others achieve only with difficulty. The semicircle has the obvious disadvantage of reducing the free-way as the level of the water rises, — the reverse of the ideal — a disadvantage that is appreciably lessened, though not entirely eliminated, in the three-centered arch.

Segmental arches, such as those of the Ponte Vecchio at Florence, or the Pont de la Concorde at Paris, are ideal from the standpoint of the free-way, but their relation to the vertical lines of the piers is so abrupt as to be almost brutal, and detracts from the charm of these structures. The designs of Perronet, the author of the Pont de la Concorde, are so carefully computed that there can be no anxiety as to their solidity, but it might be generally noted that where the arches are so lowered as to be little more than flat vaults, thus giving a practically constant free-way, no matter what the level of the stream, there is a real risk both as to the satisfactory execution and the apparent stability of the bridge.

The difficulties resulting from the use of flattened arches have been the subject of much study. The funnel shaped *corne de vache*, with a greater span but the same rise as the main arch, is one of the expedients resorted to to overcome this defect. Perronet is perhaps the most forthstanding exponent of the flattened, or segmental, arch in bridge construction, as seen in the bridge at Neuilly on the Seine. A still further application of this idea, as seen in a bridge at St. Dié on the Meurthe [1], is probably the most complete expression of this conception. It gives the impression, at least, of a road-way supported on an absolutely flat vault between vertical piers.

Among many methods that were used in an effort to overcome the difficulties resulting from the use of flattened arches, was the employment of two-centered or pointed arches. This had one good result even when the segments used were very flat, in that the arch stones, where the curves met, were at a more marked angle with the keystone than, say, in a three-centered arch, and the

(1) This bridge, designed by Lecreux in 1785, was not built until during the Empire. See diagram p. 17.

homogeneity of the arch was correspondingly improved. The bridge of the Trinity at Florence best expresses this method.

At different periods during the 2000 years covered by our bridges, interest was centered on different features of the building problem. The problem of the free-way, in its relation to the type and span of the arches, was apparently not studied with scientific thouroughness until the XVIIIth century. In the Roman period, no hesitation whatever was shown to put in as many arches and piers as seemed best, even on a river like the Tiber, whose sudden floods call for such special precautions ; as in their architecture so in their bridges, the semicircular arch prevails. A recognition of its obvious disadvantages, as indicated above, appears in the bridge of Fabricius on the Tiber, where additional openings appear in the abutments and in the central pier. This device, which only inadequately provided additional outlet for flood waters, nevertheless brought about the use of such features both as arches [1] and as oval or circular openings [2] in many bridges that were built later.

In the Middle Ages, as in the Roman period, the river-way was frequently crowded with a quantity of piers ; in place of the semicircular arch, we find the builders largely using a two-centered or pointed arch. This form of the arch necessitates a relatively slight span and therefore many piers, unless it is permissible to raise the road-way to a considerable height. So at this period, as well as in the earlier one, navigation not having become an important consideration, solidity of construction, rather than an accurate computation of the necessary free-way, was counted on to resist the force of high floods.

The Renaissance brought little progress of note ; only in Florence, as we have seen, was an effective effort made at the time, in the Ponte Vecchio and the bridge of Ammanati, to correct the defects of the older types of construction by the use of three-centered and segmental arches [3]. Gauthey frequently used semicircular arches in his bridges in Burgundy, so that it was not until Perronet undertook a full and final study of the whole subject that anything in the nature of recognition of the modern needs of free-way in relation to navigation was forthcoming. As late as 1832, in fact, the central arch of the Pont de la Concorde was referred to as the most daring construction created up to that time [4]. So thorough and exhaustive were Perronet's studies that there seemed nothing left to say or do in masonry bridges.

Just at this moment a new toy appeared — the iron bridge. Although for a time it seemed as if iron would entirely replace stone, yet with the passing

(1) See the bridges of Sommières, Montauban, Avignon.

(2) See the bridge of Echavannes, Châlon-sur-Saône.

(3) To be exact, the curves of the work of Ammanati are formed at their extrados of pointed arches — that is very flat two centered arches.

(4) Prony. Notice on Perronet read at the Institute.

of the years and a recognition of the amazing possibilities of reinforced concrete, the pendulum is swinging back, and there seems little likelihood that iron will ever be used to the exclusion of stone.

The process of selecting the most typical or interesting bridges, from the mass of material at our disposal, resulted in the discovery that those chosen were readily grouped both chronologically and geographically. This is rather



THE BRIDGE AT AIRVAULT
FROM THE PENCIL SKETCH BY LOUIS C. ROSENBERG.

curious, for bridges were built almost everywhere, and it is somewhat difficult to explain why the results should be so much more striking in some places than in others.

Chronologically, the first period is that of the Romans, beginning with the early years of Christianity. There were many bridges built at this time, and some of them still exist in a sufficiently perfect condition to give us a real conception of their beauty. Such a one, for example, as that at Sommières,



THE BRIDGE AT THOUARS
FROM THE PENCIL SKETCH BY LOUIS C. ROSENBERG.

still affords passage to both horse and foot. Others, that have suffered with the passing of the centuries, such as the great aqueduct of Remoulins, better known as the Pont du Gard, still fill us with admiration both because of their superlative construction and their imposing proportions.

The second period includes the thirteenth century and some twenty-five years on each side of it. We have of course included some that are older, such as those at Espalion and Albi, but the greater number of the best bridges built in the Middle Ages fell within the above limits. The bridges at Avignon and at Carcassonne belong to the earlier years — 1177 and 1184; Orthez dates from 1250; while those at Cahors, Céret, and Montauban are of the early years of the fourteenth century.

The third division includes the years from 1540 to 1620. Within this, in the earlier portion, are the bridges at Toulouse and Châtellerault, while in the latter we find the Pont-Neuf and the Pont Marie. These may be said to belong to the Renaissance period, for it is not until sixty years later that our fourth, or last, period begins, with the Pont Royal at Paris, and runs through the eighteenth century, including at the beginning the bridges at Blois and Juvisy, and later those by Gauthey in Burgundy, and those of Perronet in the Seine valley and near Paris.

If we now consider the geographical distribution of the bridges that have been selected, we find that it can be divided roughly into five districts, just as we arrived at a chronological division into four periods. The five divisions are as follows :

(1) The neighborhood of the Pyrénées in the southwest of France, including the bridges of Toulouse and those on the Tarn, Lot, Aude, and their affluents : in general the basin of the Garonne.

(2) The country including Languedoc in the southeast of France, with the lower valley of the Rhône.

(3) Burgundy.

(4) The Vendée.

(5) Paris and the Valley of the Seine.

This division, which is admittedly arbitrary, has resulted from the selection of bridges that we have made. A glance at the map will reveal what may not seem apparent in reading our list, that these five districts really cover only a relatively small portion of France. Our first two districts might be included in one; but even a more comprehensive list of bridges than that to which we have limited ourselves would scarcely have enlarged the field covered in the districts above. We of course know that there are fine bridges outside of these self-imposed limits, but such a classification is useful, in our opinion, if only as a point of departure.

Our first district is particularly rich in Mediaeval bridges. Here, we find the bridges of Cahors (Valentré), of Espalion and of Villeneuve-sur-Lot, also those of Orthez and Sauveterre. On the Tarn are the bridges of Albi and Montauban, and on the Aude that of Carcassonne (1). But the district also includes some fine modern bridges, such as those on the Garonne at Toulouse, at Libourne, Carbonne, and at Bordeaux; also eighteenth century bridges on the Aude, on the Douctoire, and on the Hers (2).

The district to the southeast, including the valley of the Rhône, has some fine bridges of the Middle Ages, as well as the first district. Such are the bridges of Avignon and St. Esprit, credited to the order of the Frères Hospitaliers Pontifes (3). There are also fine modern bridges at Gignac and at Villeneuve-les-Maguelonne. But it is rich, above all, in Roman bridges, even though it may contain none as famous as the bridges of St. Chamas and of Sommières, or the Pont du Gard (4).

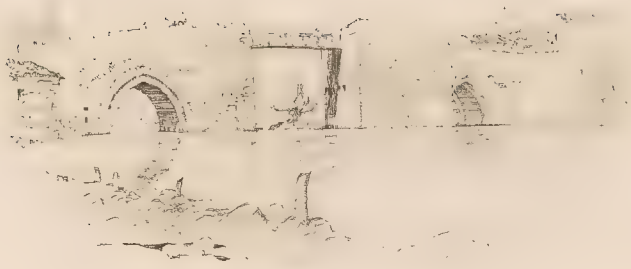
Our third district, in Burgundy, is given over to modern bridges, such as those of Gauthey, at or near Chalon-sur-Saône and outside of Auxerre.

(1) Don't let us forget the bridges of Entraygues on the Lot, of Burlats on the Agout, or of St. Affrique, and of Céret. Just outside of this region we might well mention the bridges of Bourdeilles on the Dronne, of La Voûte-Chilhac on the Allier, and of Mende.

(2) The Hers, which flows into the Ariège, is spanned by the bridges of Mazères and of Mirepoix. Between Mirepoix and Pamiers is the bridge of Rieucros on the Douctoire. Mention should also be made of the bridge of Homps on the Aude.

(3) There is much diversity of opinion as to the origin and purpose of this order, concerning which we refer our interested readers to the *American Historical Review*, october 1923 : " Altopascio, a forgotten Order " (Ephraïm Emerton).

(4) Among them are the bridges of Gallargues, of Olargues and of St. Thibery, of Vaison and the " Julian " bridge near Apt.



THE BRIDGE AT THOUARS
FROM THE PENCIL SKETCH BY LOUIS C. ROSENBERG.

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Blois and Tours, and of course there are the bridges of Paris; but the wonder is that there are so few of them and so relatively uninteresting. The bridges that span the Lot and the Tarn are admittedly notable exceptions; but compare with the above the wealth of material that we find on those little streams that flow into the Gulf of Lion, such as the Tech, the Aude, the Orb, Mosson, Vidourle, and the Touloubre, not to mention the mountainous torrents of Pau and Oloron with the bridges of Sauveterre and Orthez....

Here let us pause, to offer the reason — it may seem to us alone a justification, — for producing this book. It was an anxiety lest the needs of the automobile, combined with the cost of repairs, might result in the disappearance of these bridges that prompted the authors to present in a less technical and perhaps more available form than has hitherto appeared, the following selection from the wealth of material at their disposal. We made the selection that is shown for differing reasons : one bridge because of its unusual construction, another because of its unique location or possibly great age, while still another may be chosen for its striking size ; in the hope that thus a wider public may share with us the pleasure of a closer acquaintance with these most lovable historians of the past.

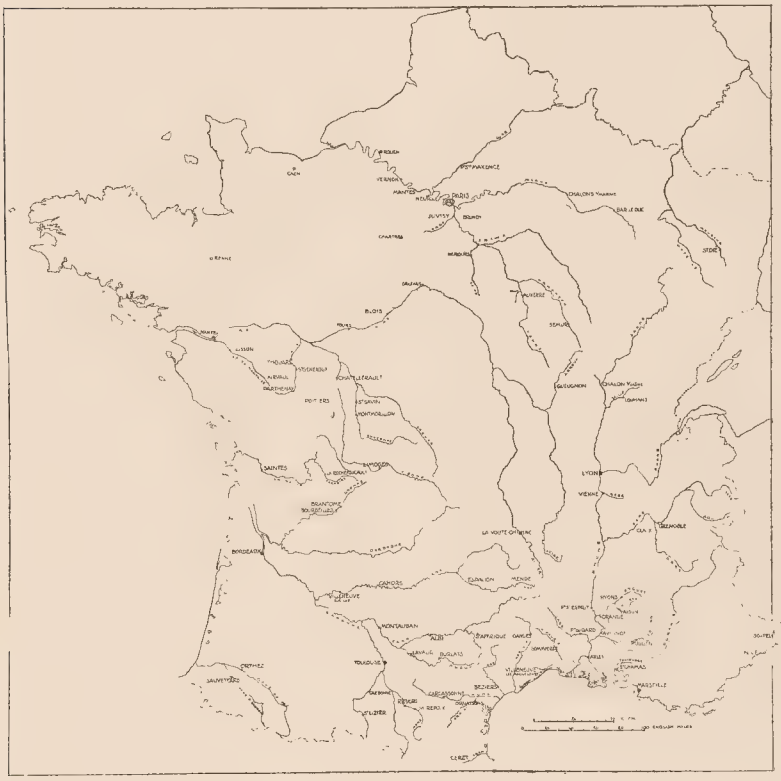
We give herewith a list of all those bridges that seem to us of sufficient interest, either from a monumental or even from a purely picturesque point of view, to justify their inclusion in the list we propose to study.

Having of necessity to limit our choice, where a complete list would have run far beyond the limits of our volume, we have preferred to select a few handsome examples of the most striking types, and thus draw the attention of architects as well as of others to a series of monuments that have been rather neglected than otherwise, but which nevertheless add much to the beauty of many a view, and to the dignity of certain cities.

Whether it has been our task to reassemble existing documents, to take measurements on the site, or simply to make drawings and sketches, we have been vastly aided by the kindness and good will of everyone. We recall with pleasure the easy access which was accorded us to the vast documentation of the Bibliothèque de l'*École des Ponts et Chaussées* and that of the Commission des *Monuments Historiques*, due to the courtesy of M. Pradel and M. Lacroix for the former and the kindness of M. Roussel for the latter. Our good friends, M. Daures of Albi and M. Bonamy of Toulouse, have given great assistance in clearing up certain questions; and it is but just to express a tribute to the valued work of a few draughtsmen, such as M. Cuvillier, M. Bernard or M. Urban, who have spared neither trouble nor time to permit us to offer to the public, today, a documentation which, possessed of other merits or not, lacks neither abundance nor variety.

In our fourth, including the Vendée and the department of the Deux-Sèvres, the majority of the bridges belong to the Middle Ages or the early Renaissance, such as those at Airvault, at Thouars, and St. Généroux, including Châtellerault and Montmorillon.

The fifth district, covering Paris and the valley of the Seine, contains



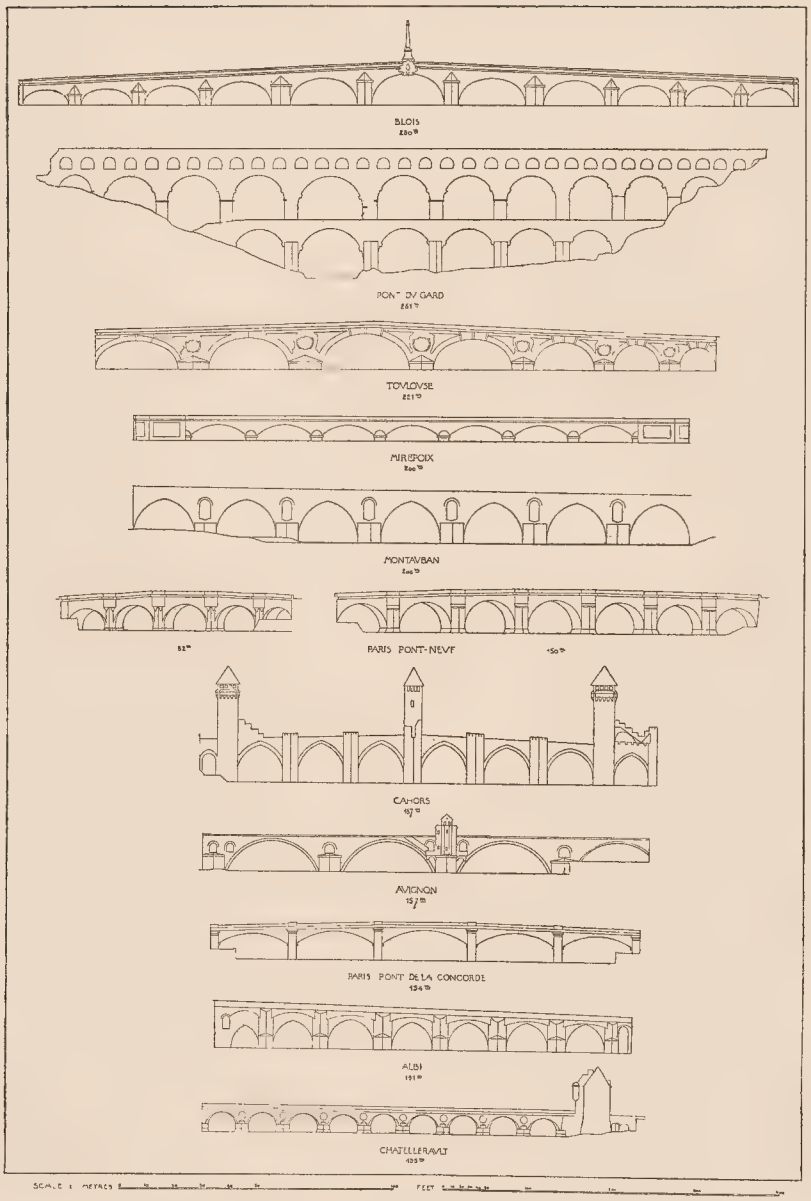
almost exclusively modern bridges, as the works of Perronet, if we except the old bridges of Paris, such as the Pont Neuf, Pont Marie and Pont Royal, which belong to the later Renaissance.

Let us make here a comment that seems significant, namely, that with only occasional exceptions the most interesting bridges are not found on the most important rivers, nor even on their largest branches, but on rivers of entirely secondary importance, some being nothing more than small streams. We have spoken of three bridges across the Garonne, two across the Loire at



THE PONT-DU-GARD

DIAGRAM AT A UNIFORM SCALE



SHOWING COMPARATIVE SIZES AND PROFILES

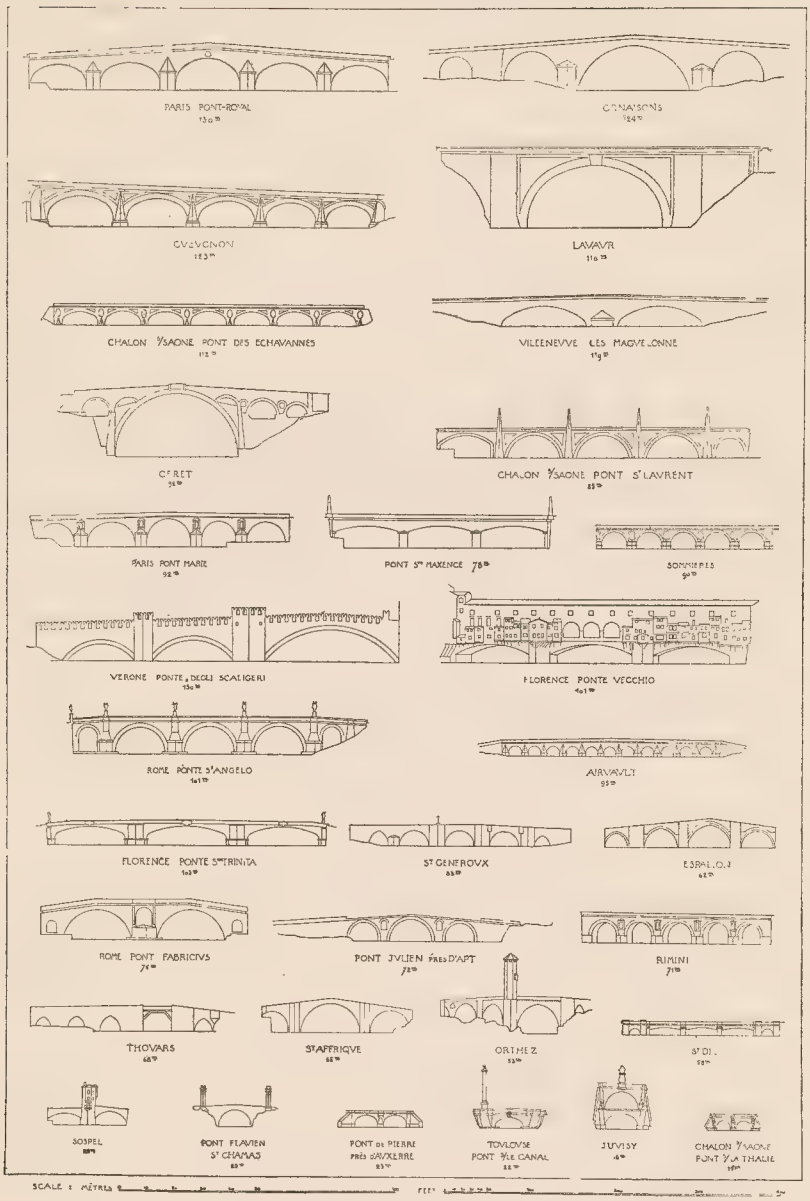
LOCATION OF THE BRIDGE	FRENCH DEPARTMENT	RIVER SPANNED	DATE	AUTHORS (WHEN KNOWN)	NUMBER OF ARCHES: PRINCIPAL	NUMBER OF ARCHES: SECONDARY	TOTAL LENGTH	TOTAL WIDTH	HEIGHT FROM WATER	WIDTH OF ARCH
							meters	meters	meters	meters
Airvault	Deux-Sèvres	Thouet	XI Cent		11		94.50	5.02	6.05	
Albi	Tarn	Tarn	1035		7	2	151	7.95	11 to 14	
Apt (Julian Bridge)	Vaucluse	Coulon	Roman		3		44.40	5.45	10.15	
Avignon	Vaucluse	Rhône	1177-1185	Hospitaliers Pontifes	4		157.10	4.72	12.70	
Auxerre (near)	Yonne	Rû des Baulches	1781-1789	Gauthey	2		22.72	14.03	4.76	
Blois	Loir-et-Cher	Loire	1716-1724	J. Gabriel	11		280	14.95	15	
Cahors (Valentré Br.)	Lot	Lot	1308-1355		6	2	167.80	5 90	16.54	
Céret	Pyrénées-Orient.	Tech	1321-1339		1		92.85	4	25.80	45.45
Chalon (St-Laurent Br.)	Saône-et-Loire	Saône	1776	Gauthey	4	1	85.27	10	12.20	
Chalon (Chavannes Br.)	—	—	1782-1790	—	7		112.17	9.82	8.06	
Chalon (near)	—	Thalie	1766-1770	—	2		16 40	6.90	4.33	
Chatellerault	Vienne	Vienne	1564-1611	Ch. Androuet	9		135.35	21.77	10.15	
Claix	Isère	Drac	1611		1		47.60	5.30	21	45.65
Espalion	Aveyron	Lot	1060?		4		62.10	4.95	9.65	
Gueugnon	Saône-et-Loire	Arroux	1783-1786	Gauthey	5		60.87	7.90	7.20 to 5.30	
Juvisy (Belles-Fontaines)	Seine-et-Oise	Orge	1727-1728	J. Gabriel?	1		14.04	19.39	15.12	
Lavaur	Tarn	Agout	1773-1786	Saget Brothers	1		116	19.50	29.74	48.75
Mirepoix	Ariège	Hers	1773-1793	Garépuy	7		201	8.76	7.50	
Montauban	Tarn-et-Garonne	Tarn	from 1311	Etienne of Ferrières Mathieu of Verdun	7		199.40	7.85	17.90	
Nyons	Drôme	Eygues			1		. . .	. . .	. . .	40.53
Ornaisons	Aude	Orbieu	1745-1752	de Carney	1	4	142.40	8.78	about 20	
Orthez	Basses-Pyrénées	Gave-de-Pau	XIII Cent				45.20	4.87	13	
Paris (Concorde Br.)	Seine	Seine	1787-1791	Perronet	5		154.38	15.60	12.32	
— (Pont Marie)	—	—	1614-1635	Christ. Marie	5		92.25	23.60	12.12	
— (Pont Neuf)			1578-1607	Marchand & B. Androuet	5 & 7		81.86 150.50	21.80	about 12	
— (Pont Royal)	—	—	1685-1687	Mansart, J. Gabriel	5		129.70	16.90	14.10	
Pont-Sainte-Maxence	Oise	Oise	1774-1786	Perronet	3		78.96	12.54	10.44	
Remoulins	Gard	Gardon	Roman		6		261	6	47.40	
Saint-Affrique	Aveyron	Sorgue	bef. 1368		3		53.76	3.46	10.68	
Saint-Chamas	Bouch.-du-Rhône	Touloubre	Roman		1		22.80	6	7.44	12.17
Saint-Dié	Vosges	Meurthe	1804-1821	Lecreux & Vigor	3	2	55.56	. . .	4.75	
Saint-Généroux	Deux-Sèvres	Thouet	XIII Cent		3	2	53.30	3.90	7.13	
Sommières	Gard	Vidourle	Roman		7		about 90	6.60	7.32	
Sospel	Alpes-Maritimes	Bévera	1784		2		28.10	5.60	6.80	
Thouars	Deux-Sèvres	Thouet	XIII Cent		4	1	55.27	6 31	7.90	
Toulouse	Haute-Garonne	Canal du Midi	1762-1764	Saget (senior)	1		22.22	11.60	5 15	
Toulouse	—	Garonne	1543-1626	Nich. Bachelier and his son	7		221.40	19.95	16.90	
Vienne	Isère	Gère	?	G. Bouchet			. . .	. . .	. . .	31.80
Villeneuve-les-Maguelonne	Hérault	Mosson	1768-1778	Giral	2		119	8.27	12.41	
Florence	Italy	Arno	1567	Ammanati	3		102.90	10.55	8.50	
Rimini	—	Marecchia	Roman		5		70.86	7.70	10	
Rome (Quattro Capi)	—	Tiber	—		2		76		13.40	
— (S. Angelo)	—	—	—		3	2	101	13.70	12	

All the measures are given here in *meters*. We may remind that the french meter stands for 3 feet 3 inches 3/8 and 10 meters for 32 feet 9 inches 3/8.
The value of the foot is exactly 0, 324794 meter.



THE S. PETER BRIDGE, BAR-LE-DUC
FROM THE PENCIL SKETCH BY SAMUEL CHAMBERLAIN

DIAGRAM AT A UNIFORM SCALE



OF THE BRIDGES REFERRED TO IN THE TEXT.



THE PONT DU GARD, REMOULINS
FROM THE PENCIL SKETCH BY LOUIS C. ROSENBERG

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of the sides of a street or a square without a sign of a sidewalk in a southern town, but even a little township in the north would insist on the need of an adequate sidewalk, just as it would not permit its rivers to be encumbered with the ruins of an old bridge, once a new one has been established in its place. Do not the ruins of the Æmilian bridge still encumber the middle of the Tiber?

Whether or no the above sufficiently explains the facts that are before us, there is no doubt that evidences of Roman bridges, and in usable condition, are much more frequently encountered today in France than the restorer of Pierrefonds and Carcassonne would lead us to think. These are, naturally enough, found on that great system of roads that Strabo tells us Agrippa determined should have its center at Lyon (*Lugdunum*), whence four main roads stretched out towards, first, the shores of the Channel; second, the mouth of the Rhine; third, the Ocean (finishing at Saintes); and fourth Spain, by way of Arles and Narbonne.

The successive sections of these roads from town to town are well known to us today[1], and it seems of interest in our study to follow the itinerary of the road leading from Lyon towards the Pyrénées. As far as Tarascon, this was identical with the main road (fourth in our list) to Spain, by way of Arles and Narbonne. It followed along the valley of the Rhône, by Vienne (*Vienna*) and Valence (*Valentia*), through Orange (*Arausio*) and Avignon (*Avenio*). Turning off as we have noted at Tarascon (*Tarasco*), it went to Nîmes (*Nemausus*), and thence southward to Elne (*Elena*), thus crossing on its way all those coastal streams that flow into the Gulf of Lion, on which we find so many old bridges. Turning towards the Garrigue Mountains, another road, by way of Lodève (*Luteva*), started towards Rodez and Limoges.

We are furthermore interested in outlining the three main roads that led from northern Italy, or Cisalpine Gaul, into the valley of the Rhône, or Transalpine Gaul. The first, which kept to the south of the Apennines and even of the Alps, came into Gaul by way of Nice and Frejus (*Forum Iulii*). Although its route included no mountain passes, it does not seem to have been the most used. The road that was most convenient for travelers going directly to Lyon and beyond (our second), started at Aoste (*Augusta Pretoria*); it crossed the mountains at the Little St. Bernard pass, and thence, via Bourg St. Maurice (*Bergintorum*), along the valley of the Isère to Moutiers (*Darantasia*), as far as Montmélian (*Mantala*). From this point it struck out towards Vienne (*Vienna*), via Aoste [2], Bourgoin (*Bergusia*), and thus to Lyon.

(1) From roman travellers' journals, from the works of Walckenaer and of the *Commission de la Carte des Gaules*.

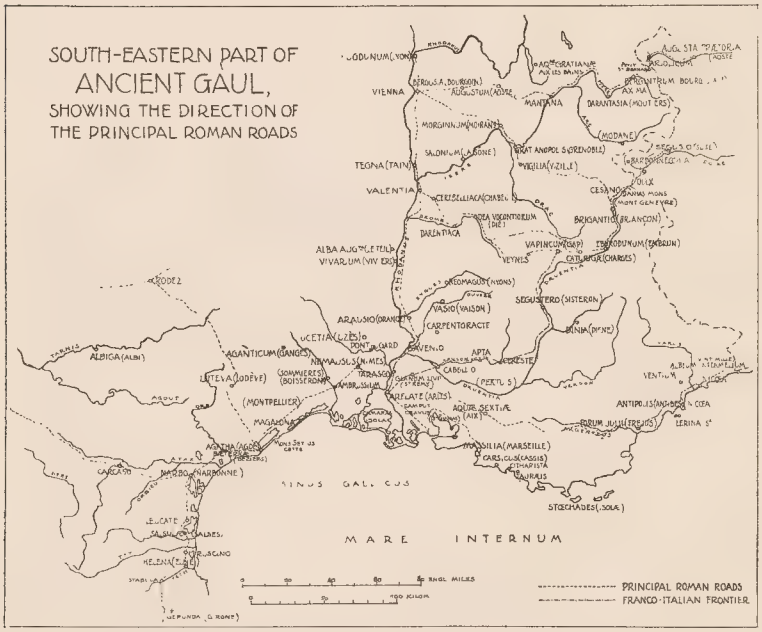
(2) Not to be confused with the starting place of this road.

A WORD ON THE ROMAN BRIDGES

In his " Dictionary of Architecture ", Viollet-le-Duc tells us that " stone bridges of Roman construction and still in evidence are rare ". He adds that if there had been many of them, we should find their ruins on the rivers. Our own experience, on the contrary, leaves an impression of the surprising number of Roman bridges still to be found throughout Provence and Languedoc. These are sometimes sufficiently well preserved to still be used for their original purpose; within an area of a few square kilometers we actually find three : — Sommières, Gallargues and Boisseron.

Needless to say, these structures could not have been originally confined to Provence and Languedoc alone. But why have they so largely disappeared except in the districts near the Pyrénées and the Mediterranean ? Two explanations suggest themselves : the climate, for one, is certainly much more destructive in the north with its greater extremes of temperature; but this hardly seems a sufficient explanation by itself. A second, and more far-reaching cause for their disappearance seems to us to lie in certain inherent characteristics that distinguish the dwellers in northern climates from those in the south. The former, once he has decided upon a change, carries through his new idea with a thoroughness that eliminates the last vestige of that which had taken its place, while in the south there is an easy going tolerance that permits the old to exist allongside of the new. Thus it is easy to conceive one

Thus these Roman roads, bearing such astonishing tribute to the capacity of their builders, lead us over bridges that command our admiration today for their beauty as well as for their masterly construction, and, we trust, justify this digression into a somewhat archaeological field.



The remaining road made use of the valley of the Durance. Starting at Suse (*Segusio*), it followed at first, as far as the neighborhood of Oulx, the valley of the *Doria Riparia*. Here, instead of turning north as the Mt. Cenis railroad now does, it turned south, crossing the Alps at Mt. Genèvre (*Janus*), and soon reached Briançon (*Brigantio*) on the Durance. It follows this valley to Embrun (*Ebrodunum*), where it turns westward to Gap (*Vapincum*). At this point, a lesser road leads, via Dié (*Dea*), to Valence (*Valentia*) and thence up the Rhône to Lyon. At Gap, however, the main road turns southward



The bridge at Olargues, by L. C. Rosenberg

and rejoins the valley of the Durance for some distance, before crossing over to that of the Coulon. Between here and Arles (*Arelate*), which the road reaches by way of Apt, Cavaillon (*Cabellio*), and St. Rémy (*Glanum Livii*), we find two bridges at Céreste and another near Apt.

This general region at the outlet of the valley of the Rhône contains, somewhat aside from the exact lines that we have followed, such structures of note as that at Vaison (*Vasio*), the Flavian bridge at St. Chamas, the imposing ruins of the aqueduct which brought water to Nîmes from a spring in the neighborhood of Uzès (*Ucetia*), as well as the bridges at Gallargues (*Ambrussium*), Sommières and Boisseron.



THE PONT-DU-GARD

three meters, but their width shows wide variations; the total length at this level being 261 meters.

A chalky deposit, which in some instances reaches a thickness of 30 centi-

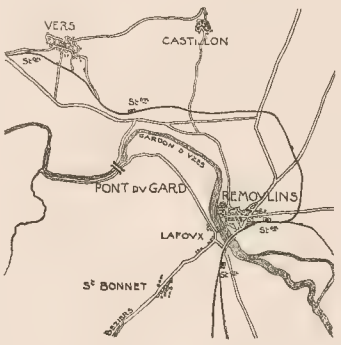


meters, partially fills the opening (1.25 meters wide and 1.80 meters high) through which the water flowed, and bears ample evidence of the centuries of usefulness that this mighty monument has provided. This portion alone of the entire structure is carefully cemented and covered with large stone slabs. All the rest of the stonework is laid dry, which indeed is characteristic of most Roman work; not even metal anchors were used, the perfection of the stone cutting being such as to make the use of cement entirely superfluous.

THE PONT DU GARD

The great aqueduct known as the "Pont du Gard" is the most famous as well as the handsomest of the many masterpieces left by the Romans throughout France. It crosses the valley of the Gard, an affluent of the Rhône, about two kilometers from Remoulins[1], and carried on its uppermost arches, some 50 meters above the river, the sweet waters of the Airon and the springs of the Eure, from near Uzès to Nîmes, 40 kilometers away.

Its general appearance is sufficiently well known to our readers, but some facts concerning the successive tiers of arches may be of interest. At the lowest level there are six large arches, spanning a distance of 150 meters. Five of these vary from 15.45 to 19.20 meters in span; the sixth, under which the river flows, reaches a width of 22.44 meters, the structure, at this level, being 20.50 meters above the river and seven meters thick. From the level platform crowning this first row of arches, rises a second tier of superimposed arches with just the same span, but 11 in number because of the increased width of the valley resulting from its sloping banks. On the second platform, which is 250 meters in length and 40 meters above the river, rests the third and uppermost row of 35 arches. These have an approximately uniform diameter of 4.80 meters, and are distributed in groups of three or four, as the span of the lower arches may determine. The piers of this topmost row have a thickness of about



(1) Remoulins lies on a straight line midway between Avignon and Nîmes, and about 20 kilometers distant from each.

three meters, but their width shows wide variations; the total length at this level being 261 meters.

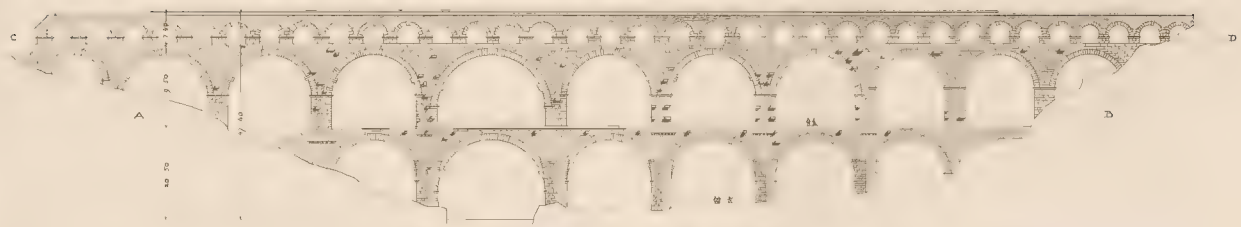
A chalky deposit, which in some instances reaches a thickness of 30 centi-



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PONT DU GARD NEAR REMOULINS

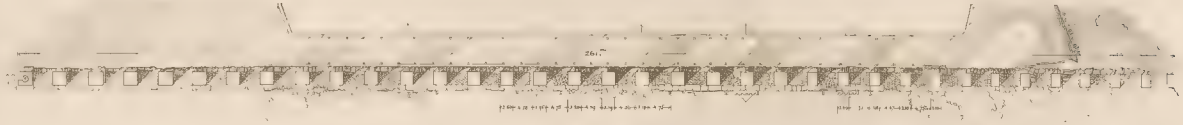
(1ST CENT. A.C.)



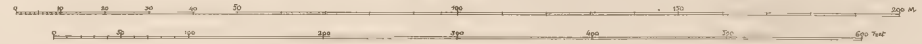
ELEVATION FACING

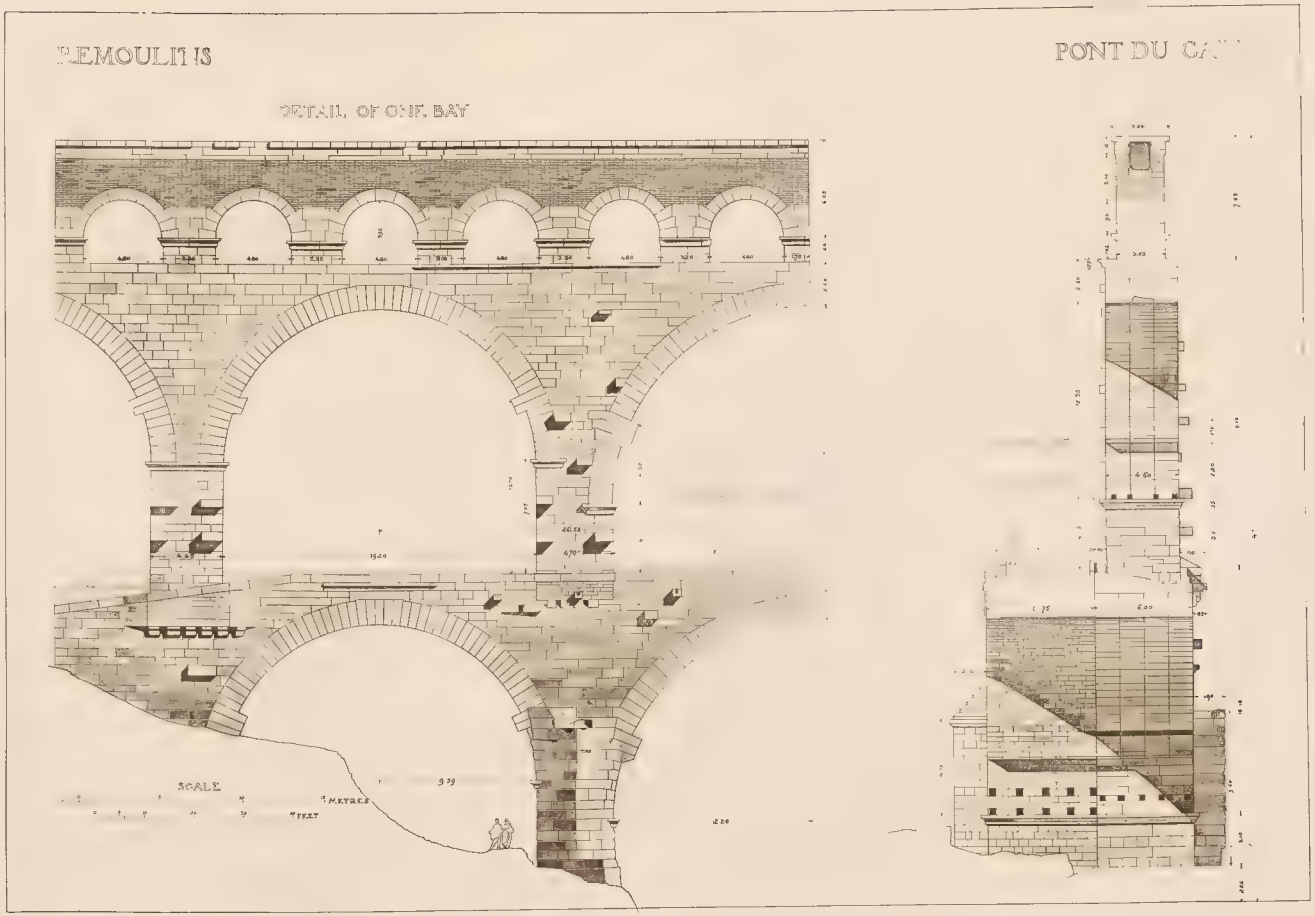


PLAN ON AB



PLAN ON CD




REMOULINS
DETAIL OF ONE BAY
PONT DU GA
SCALE
METRES
FEET

It is difficult to give any exact date for the construction of the Pont du Gard. Tradition has it that it was built by order of Vipsanius Agrippa, son-in-law of Augustus, whose name appears to this day on the pediment of the Pantheon in Rome, and to whom, for one reason or another, many other monuments seem to have been attributed. On this assumption the Pont du Gard would seem to belong to the early years of the Empire. This does not seem improbable, as Gaul became a Roman province in 50 B. C., and it was customary for the wide-flung evidences of Roman civilisation to follow close on the heels of peace.



Even this most admirable monument, which entirely eclipses anything of a similar nature that has been built since, has suffered truly terrible depredations. These, first, brought about its disuse as an aqueduct, and would certainly have resulted in its absolute destruction if skilful restorations, made in 1855, had not repaired the damage at least temporarily. The cruellest blow was dealt in the XVIIth century when the entire region was ravaged by religious wars. Though in no way planned for use as a bridge, the aqueduct might nevertheless be serviceable as a means of passage, particularly for fugitives; but imagine using it for artillery!... To make this possible they followed the crude and barbarous procedure of cutting into one side of the piers of the second tier to secure a bearing for the roadway, the railing resting on brackets which were corbelled out from the same piers. They accomplished their purpose, but with such disastrous consequences that the entire structure

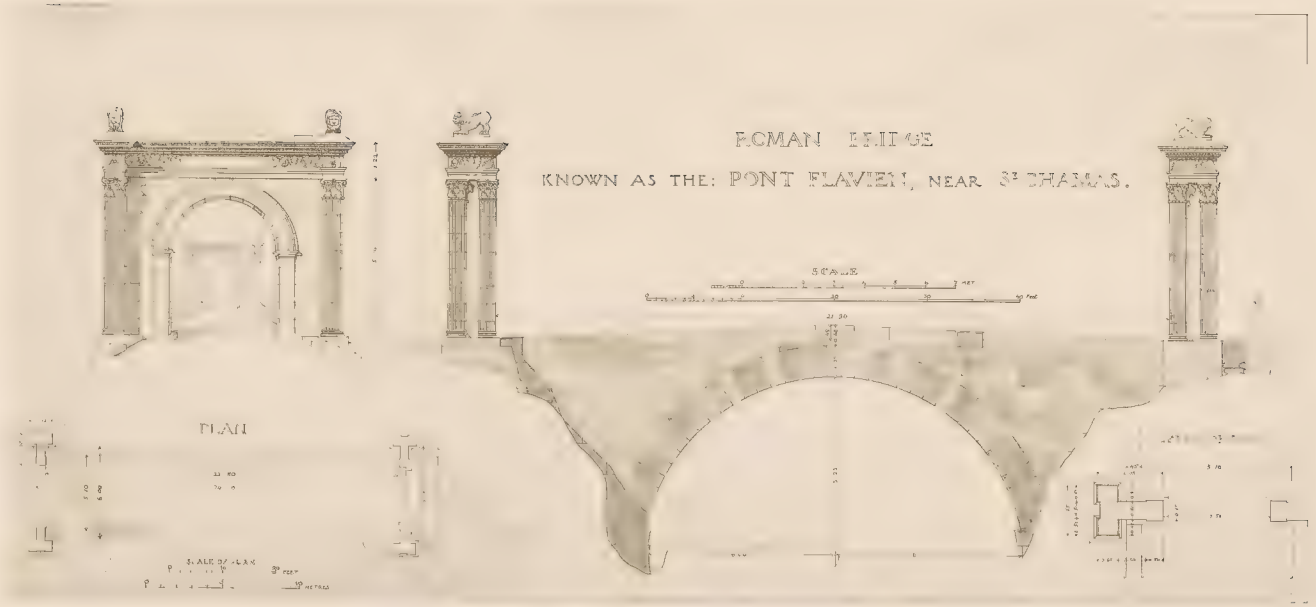
would have collapsed in a short time, had not the governor of Languedoc, Lamoignon de Baville, appreciating the danger, taken immediate steps to repair the damage while it was still possible.

This was accomplished in 1669, while the restoration of 1855 should be credited to Questel and Laisné. Since the latter date no pains have been spared to keep the structure in the best of condition, but some idea of the extent of the original damage can be gained from the fact that the upper platform shows a depression from the vertical face of more than a meter.

It was decided in 1747, in order to facilitate communication from side to side, to build a roadway on the down-stream face, carried on arches identical in dimension with those of the first tier. This new work had a width of 6.80 meters, which, when added to what had previously existed, gave a surface 12.75 meters wide. The construction of this modern addition is frankly different from the older work, the arches of the latter being built up, in Roman fashion, of four adjacent sections, operating entirely independently. It should also be noted that the stonework is in pieces of large dimensions, which were quarried near-by, on the left bank of the Gardon.

The up-stream view of this glorious relic of the past is still most striking. The passing centuries have given to the stone work on this side a mellow texture that suggests Roman *travertino*. Its general mass is impressive in color, in outline, in actual dimensions, as well as in the harmony of its proportions : it is a ruin of inestimable value.

It may not be out of place here to quote the impression it made on J.-J. Rousseau : "It was the first work of the Romans that I had seen. I hoped to see a monument worthy of the hands that had raised it; and for the first time in my life my expectations were surpassed by the reality. It belonged only to the Romans to produce such an effect. The aspect of this simple and noble work struck me all the more that it was in the midst of a desert where the silence and solitude increased its effect... I walked along the three stages of this superb construction, with a respect that made me almost shrink from treading on it. The echo of my footsteps under the immense arches made me think I could hear the strong voices of the men who had built it. I felt lost like an insect in the immensity of the work. I felt, along with the sense of my own littleness, something nevertheless which seemed to elevate my soul; I said to myself with a sigh : " Oh! that I had been born a Roman!..." I remained several hours in this rapture of contemplation. I came away from it in a kind of dream, and this reverie was not favorable to Madame de Larnage [*the latest of the numerous objects of Rousseau's sentimental attachments*]. She had been careful to warn me against the attractions of the young women of Montpellier, — but not against the Pont du Gard ".


ROMAN BRIDGE
KNOWN AS THE: PONT FLAVIEN, NEAR St. CHAMAS.
PLAN



THE BRIDGE AT SAINT CHAMAS

THE PONT FLAVIEN AT ST-CHAMAS (Bouches-du-Rhône) AND THE PONT JULIEN NEAR APT (Vaucluse)

Among the many Roman ruins that may still be found scattered throughout Provence and Languedoc, hardly one remains in such a perfect state of preservation as the charming little bridge of St. Chamas, known in the region by the name of the Pont Flavien. St. Chamas is a station on the line from Paris to the Mediterranean. It is about 50 kilometers north of Marseilles, and reached just as we come upon the great swamp of Berre [1], and after passing Miramas.

It is a sheltered little bridge in a smiling, picturesque location. Placed on the south side of the town, it provides a crossing over the little stream of the Touloubre for roads coming from Aix and from Langon, while the Touloubre itself, flowing from the north, empties forthwith into the swamp of Berre. The bridge consists of only one semicircular arch with a diameter of 12.34 meters, and an over-all width of six meters.

The distinguishing feature, however, of this bridge is that it is reached from either side through a triumphal arch. These arches, which are 22.80 meters apart, are identical, each having an arched opening of 3.56 meters. They are distinctly Roman in proportion, with low centered arches, and both, because of their general appearance as well as of a certain firmness of the mouldings of the archivolt, might well be attributed to one of the best periods, were it not that the monotonous repetition of certain details in the cornice and the spirit of the decoration, not without analogy with that of the Arch of Septimus Severus, combine to indicate a date as late perhaps as the beginning of the third century.

We should be careful to note that there is no reason to believe that just because the bridge is known locally as the Pont Flavien it was built therefore under the Flavien dynasty, or towards the end of the first century A. D. The

(1) This swamp is not only large and navigable, but opens directly into the sea.



name by which it is known is really explained by the inscription that is on the frieze of one of the arches, in which reference is made to a certain Flavos. The inscription is as follows :

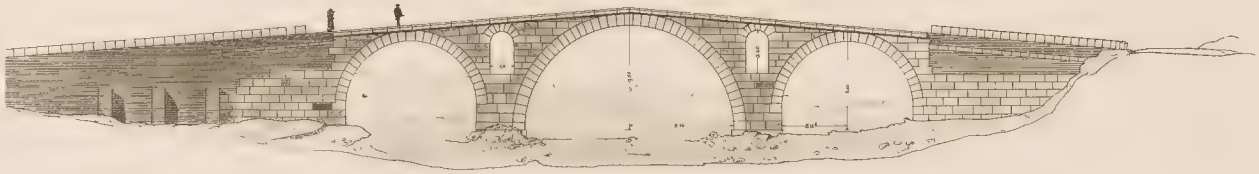
CL. DONNIUS S. C. E. FLAVOS FLAMEN ROMÆ
ET AUGUSTI E TESTAMENTO FIERI JUSSIT

indicating that it was this Donnius Flavos, a priest from the temple of Rome and Augustus, who, in his will, ordered the erection of this pleasant little monument.

We thought it might be interesting, after the bridge of St. Chamas, to point out one of the very old bridges of the valley of the Coulon. It is situated along the Roman road of which we have spoken, forming a link in this highway which crosses the Mont Genèvre and the valley of the Durance and thus connects Arles and Suse. This bridge, of which we give a reproduction, is located about seven kilometers (four miles) west of Apt, as the crow flies, on the road from Montpellier to Coni; the road, which borders there the Coulon, passes very near this little monument, which is less interesting, it is true, than the bridge of St. Chamas, but well situated and comparatively well preserved.



ROMAN BRIDGE, NEAR THE ROAD FROM APT TO CAVAILLON, KNOWN AS THE PONT JULIEN



ELEVATION



SECTION AB



PLAN



SECTION CD

SCALE 0 5 10 20 30 40 METRES

0 10 20 30 40 50 60 70 80 90 FEET

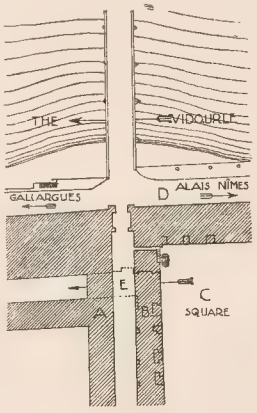


A CURIOUS OLD BRIDGE AT CAVAILLON

THE ROMAN BRIDGE AT SOMMIÈRES (GARD)

It is by means of this bridge that the road from Le Puy to Montpellier crosses the Vidourle, a small costal stream that flows into the Gulf of Lion not far from Aigues-Mortes. This region, as we have stated elsewhere, is particularly rich in evidences of Roman civilization. Without particular reference to the Pont du Gard, that we study in detail elsewhere, we find, for instance, only half a mile distant from Sommières a Roman bridge over the Bénovie, and only a dozen kilometers to the southeast that of Gallargues. Fortunately, the bridge of Sommières has come down to us in its entirety.

It has one striking peculiarity : only seven of its seventeen arches actually play the part of a bridge. This is the consequence of the building of a dyke to protect the city from periodic inundations, with the result that the river is confined to a width spanned by the seven arches mentioned above, the balance of the bridge having become the principal street of the town and being lined by houses built upon it. These houses, as shown at A and B on the plot plan, have their ground floors level with the roadway, while their basement stories are lighted through the bridge arches facing the public square at C on a lower level. The level of this square C is actually that of the river from which it is separated by the dyke D, on which in turn modern houses have been built along the quai. The old arches are still perfectly visible, particularly at the point E where a street passes through one of them under the main street, which is in fact the bridge.



It is at this point that you can get the best impression of the truly Roman character of the construction, for here we can see that the arches are built, as at the Pont du Gard, of four rings placed side by side without any connection. Each ring is about 1.65 meters in depth, giving the bridge a total width of 6.50 meters, the length amounting to 150 meters.

The thirteen central arches carry the roadway at a level, only the last two at each end showing an incline. While, as we have said, the bridge is still intact and in use, its original appearance has suffered materially with the passing of time. Restorations, which were made at a time of which we cannot be certain, were carried out without regard for the rustication of the stonework, nor even for the actual stone-courses of the original Roman work. A later restoration, belonging to the middle of the last century, was much more systematic, and corrected some of the damage referred to above; but, by replacing the original stone parapet with a cast-iron railing, a considerable portion of the Roman character of the bridge was simply eliminated.

Each pier is pierced by an arched opening of rather stilted proportions. Curiously enough, the arch form is only carried through the thickness of the two outer rings of the four of which each arch is composed, the thickness of the two central rings being covered by stone slabs, — three for the two sections.

Nothing positive is known as to just when this bridge was built. Mr. de Dartein calls our attention to the unusual profile of the crowning member, incidentally the same as that of the impost, as being similar to the corresponding member on the bridge of Ascoli (1) which belongs to the time of Augustus. It is true as well that the bridge of Fabricius (2) shows a similar analogy. On these lines we would seem justified in assigning the bridge of Sommières to the early years of the Christian era, an hypothesis which seems entirely probable when we recall the activity shown by the Romans in their colonization. We would seem justified in this position even without attaching any particular importance to the similarity in mouldings, which in itself could hardly be considered a final argument (3).



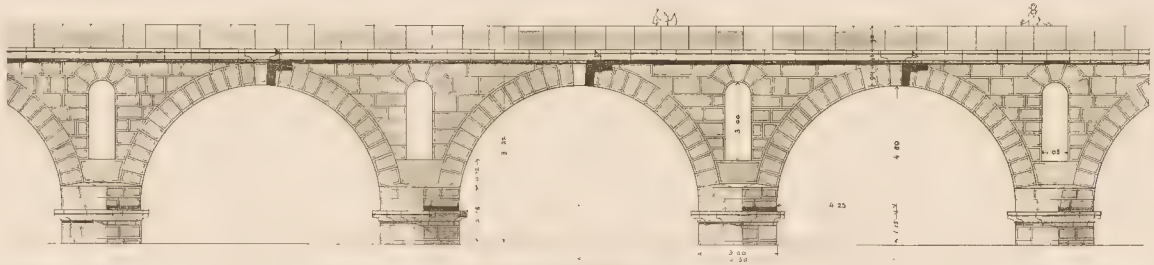
Rome
Quattro Capi

(1) This refers to Ascoli Piceno, the *Asculum Picenum* of the ancients. It is about 25 kilometers from the shore of the Adriatic, and 140 kilometers northeast of Rome.

(2) The bridge of *Quattro Capi* at Rome. It dates from 62 B. C.

(3) A very characteristic moulding treatment is also to be found both on the ground floor of the *Guardia Vecchia* at Verona and on the arenas opposite. If we knew nothing about the origin of these two structures, this detail might prove very misleading.

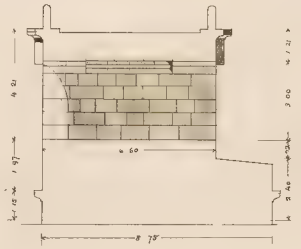
SOMMIERES GARD — ROMAN BRIDGE

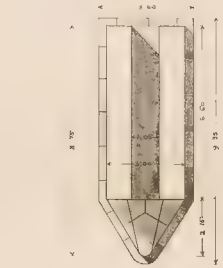


ELEVATION OF CENTRAL ARCHS

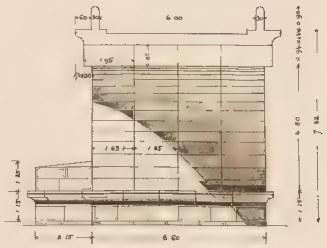
PLAN OF PIER

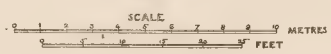
SECTION AB





SECTION CD





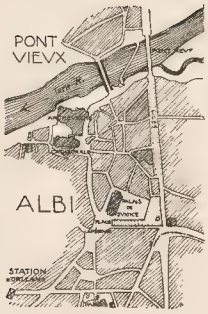
THE BRIDGE AT ALBI ON THE TARN

As one of the oldest in France, outside of those of Roman origin, this bridge is particularly worthy of our attention. It yields to none in its striking location, dominated by the ship-like mass of Albi Cathedral rising above the turbulent waters of the Tarn. None has suffered more during the centuries from flood and from neglect, so that none is better entitled to the consideration and care which, in its advancing years, have resulted from its recent classification among those historical monuments under the charge of the Government.

It is probable that this bridge dates from the first half of the eleventh century[1]. At any rate it was in 1035 that an assembly decided upon this exact spot for the crossing of the old road from Italy to Spain. This road, as a matter of fact, was a continuation of the Roman road to Lyon, that went on to Toulouse by way of Le Puy and Albi. There is, however, no assurance of the actual existence of the bridge until 1178, when it was crossed by the Abbé of Citeaux and the Bishop of Bath, with their troops on the way to attack the Viscount Roger. This date is only one year later than that of the beginning of the famous bridge at Avignon in 1177.

The bridge as we see it today is much modified from its original form. The brick-work, that forms such a pleasing contrast with the original stone structure on the up-stream side, and that entirely covers the down-stream elevation, was added, as we shall see later, in the nineteenth century. A careful

(1) The authority for this statement is an article by Mr. Emile Jolibois, archivist, in the *Revue Historique et Littéraire du Département du Tarn* for March 1879, of which we learned through Mr. Daures, Government Architect.



study of the existing facts will, however, suffice to give a clear idea of exactly what has happened.

The basic structure was entirely in stone, with slightly projecting, flat, rectangular piers on the down-stream side, and triangular piers of much more marked projection above the break-waters on the up-stream side. The projection of these piers on both sides of the bridge was utilised, at the level of the roadbed, to give additional width where vehicles might pass one another, or pedestrians seek shelter from trafic, — a very useful feature in a bridge where the width, between parapet walls, hardly exceeded 13 feet. Even so, the width was inadequate, and was increased on the down-stream side by setting out the face of the bridge flush with the face of the piers. A corresponding increase was made up-stream by throwing segmental arches of brick between the upper parts of the triangular piers well above the old stone arches. The arches in the re-facing of the bridge down-stream correspond exactly with the curve of the original pointed arches, while on the opposite side the contrast in both curve and material between the new and the old arches gives a play of color and of light and shade that is one of the particular charms of this bridge.

In this process of re-establishing the picture of the older structure, it should be noted that there was originally a tower on the central pier, chiefly occupied by a chapel dedicated to St. Firmin. There were also two entrance towers, one at each end, which are known to have been in existence until about 1615.

The attempts to keep the bridge in usable condition were inevitably affected by acts of God and of man that transpired during the eight hundred and more years that have passed since its construction. The records of the town of Albi give us the story of how repairs were under way in 1368, at the time when the English occupied this part of the country. A thorough-going rebuilding was undertaken in the early years of the fifteenth century, at which time houses were built on each pier — a procedure that must have badly hampered circulation. Again in 1445, taxes were established with the idea of making further repairs, while in 1535 the city brought suit against its Bishop who had built a mill on the left bank of the river too close to the bridge.

It was at this latter time and in this connection that a masonbuilder named Jehan de Beaujeu made an examination of the bridge and reported on the design of the piers in the following manner: "It is a defect in the piers that they should not be pointed at the back as well as in front, for as the prow in front divides the water, so a similar prow at the back would allow the water to come together gradually without creating whirlpools that undermine the



THE BRIDGE AT ALBI

foundations of the piers." This commentary has been generally recognized as sound. The bridge underwent further modifications at the time of the flood in 1609, when the two entrance towers disappeared as well as the houses that had been built on the pier nearest the city. The bridge of this period, forming part of a system of fortifications, appears in an engraving of the year 1642 on a map of the diocese of Albi.

It was the flood of 1766, however, that caused the most destruction. The piers were damaged, one of the arches was cracked and the parapets were swept away, and the houses had to be torn down. But there was no money to pay for even what was essential. All that could be accomplished was the rebuilding of the parapets and the binding together of the arch that was the most damaged. Even though the Revolution had the indirect result of placing the care of the bridge under the charge of the state, still no money was forthcoming : it was only with the coming of the Empire that the engineer of the district made urgent demands for help; and, even then, he had to await the return of the Bourbons before the work was actually started.

At the special intervention of the Duc d'Angoulême, the report made by the engineer in 1804 was approved, but the work even so was limited to the widening of the bridge on the down-stream side alone. It was consequently not until 1820 that the work on both sides of the bridge was undertaken, with the result that anyone may see at the present day, though time and circumstance have added their magic touch to man's limited effort.

Its commanding position, both from an economic and a strategic point of view, made it inevitable that this bridge should play an important part in the ceaseless struggles that marked the period and the neighborhood. The sixteenth century saw Catholics and Protestants constantly at one another's throats, and even earlier there had been the bitter crusade against the Albigenses. In 1409 and 1421 two noteworthy processions crossed the bridge : the first went to Notre-Dame de Ladrèche to pray that the pestilence might end, and the second followed the same pilgrimage on behalf of the success of the arms of the *Dauphin*, while 1535 saw still a third procession that



had been ordered by the Cardinal-Bishop Duprat against the Reform.

At the time of the massacre of St. Bartholomew, although the Protestants had been driven out of Albi, a few unfortunates, who had been imprisoned on suspicion, were thrown from the bridge into the Tarn. A similar happening occured from the bridge at Orthez : in fact, these religious struggles scarcely ceased until the promulgation of the Edict of Nantes. In 1629 the city of Albi received a distinguished visitor in the person of Cardinal Richelieu who, following the siege of La Rochelle, made a short stop at Albi and crossed the bridge on his way to Montauban. Twice again it is recorded that the notables of the town presented themselves at the bridge-head to welcome visitors of distinction. In 1659 it was to receive the Duke and Duchess of Arpajon, and in 1815 to welcome that good friend of our bridge, the Duc d'Angoulême, whose sponsoring of its needs was, as we have seen, so immediately efficacious.

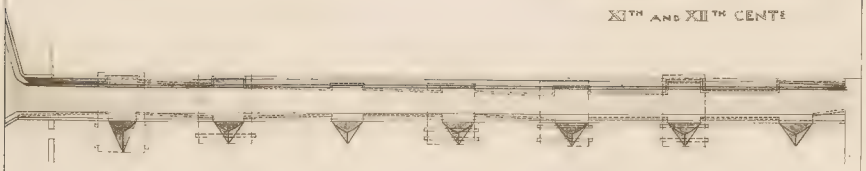
With the friendly aid of the Duc d'Angoulême anxiety for the existence of the bridge ceased, and now that it has become one of the recognized historic monuments of France, we may feel at ease as to its future.



ALBI

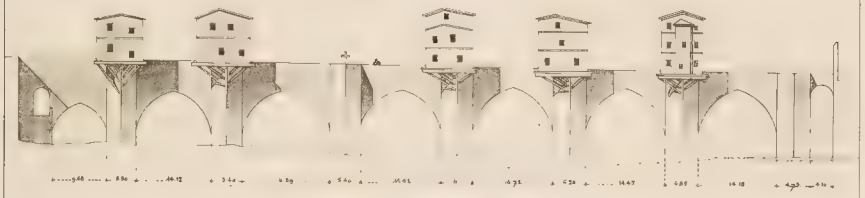
BRIDGE ON THE TARN

XITH AND XIITH CENTS



PLAN

THE DOTTED LINES SHOWING
THE FORMER CONDITION



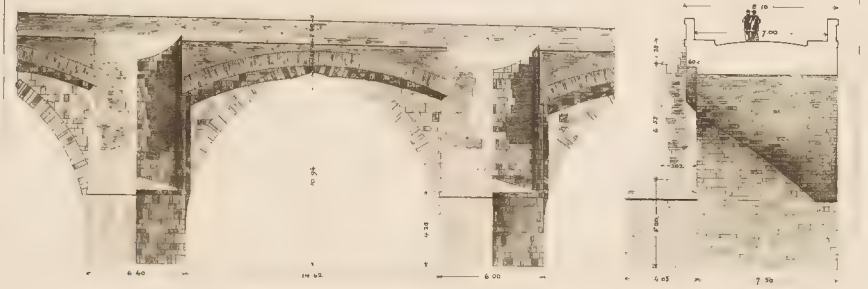
ANCIENT UP-STREAM ELEVATION

SHOWING THE HOUSES EXISTING BEFORE 1766



PRESENT ELEVATION (UP STREAM)

SCALE FOR PLAN AND GENERAL ELEVATION



DETAIL

SECTION

THE BRIDGE OF ESPALION ON THE LOT

This is indeed a venerable bridge and most appealing. The fact that its stonework is in a sad condition is to be regretted, but we must admit that it nevertheless adds a certain quality to its general appearance. It is entirely built of red sandstone, with architectural qualities that are distinctly reminiscent of the bridge at Cahors because of the abrupt manner in which both walls and piers rise sheer from the river level to the top of the parapets.

It lies on the road from St. Flour to Rodez at the entrance to the town of Espalion, just where this road crosses the Lot[1]. As it measures only 60 meters between embankments, it is not noticeable because of its size; indeed, it has a free-way of only 45 meters, but its four arches are nevertheless impressive, and though deprived of any decorative element, they have both scale and beauty of proportion.

It is usually possible to secure information about the origin of most bridges, as their construction gives rise to so many decisions, whether royal or merely municipal, that are of necessity recorded. There is generally an estimate or contract, or even a date for laying the corner-stone, but curiously enough there is no definite information on any of these points in regard to the bridge at Espalion, although archaeologists and others have given the matter much careful consideration. We are consequently constrained to pass on the local tradition which holds that both town and bridge were founded by Charlemagne at the time when he gave battle to the Saracens, namely 778. It is even intimated that the bridge may date from the time of Charlemagne's predecessor Pipin.

Both of these theories seem to us rather far-fetched. The quality and character of the architecture is not so different, as we have noted above, from that of the bridge of Valentré, which dates from 1308, so that on this basis we

(1) The " route nationale " has, however, been diverted so as to cross the new bridge since that was built (1842).

might assign the bridge of Espalion to the XIIIth century. Most painstaking investigations have, however, been made in this connection by the archiviste H. Affre[1], and although he did not succeed in establishing an exact date for the building of the bridge, he did find reference to it in a document of 1060, so that it would seem to be a monument at least of the XIth century.

Like many structures of the Middle Ages it is unsymmetrical. It may be said to consist of two distinct parts, unequal and dissimilar. One portion, that composed of the first three arches, is symmetrical on its own axis, as two arches, each 12.60 meters in span, act as a setting, or frame, for a third, which is three meters wider. It is at the crown of this large arch that we come to the highest point in the steeply sloping lines of the bridge: the grade is actually greater than ten per cent. We thus have one portion symmetrical in itself, forming a unit, following which comes the second, made up of a single arch, which is both narrower and lower and connects the bridge with the right bank opposite the town.

This last arch is marked by a lack of the archivolt that characterizes the three main arches, while the pier that receives it is not only two meters wider than the others, but very nearly square in plan[2]. If we take into consideration the general similarity of this structure to other fortified bridges, it seems fair to assume that this square base served as foundation for a defensive tower such as we find at Orthez or Sauveterre, but particularly suggestive of the first of the towers on the bridge at Cahors.

We have already commented upon the architectural similarity that characterizes these two bridges, both spanning the river Lot, and at a distance of 120 kilometers from one another. It remains to point out that at Espalion, as at Cahors, the arches are pointed, even though the crown is very little higher than would have been the case had they been semicircular. As it is practically impossible to determine the exact centers for the curves of these pointed arches, we have made an approximation which would give a radius of 8.45 for the largest arch, measuring 15.50 meters in span, and would place the centers only 70 centimeters on either side of the axis[3]. The first arch from the town side gives so slight an impression of being pointed that, in consequence of the irregularities resulting from the poor condition of the bridge, it is actually impossible to state positively whether this is indeed a pointed arch.

As decoration there exists, following the curve of the three main arches, a

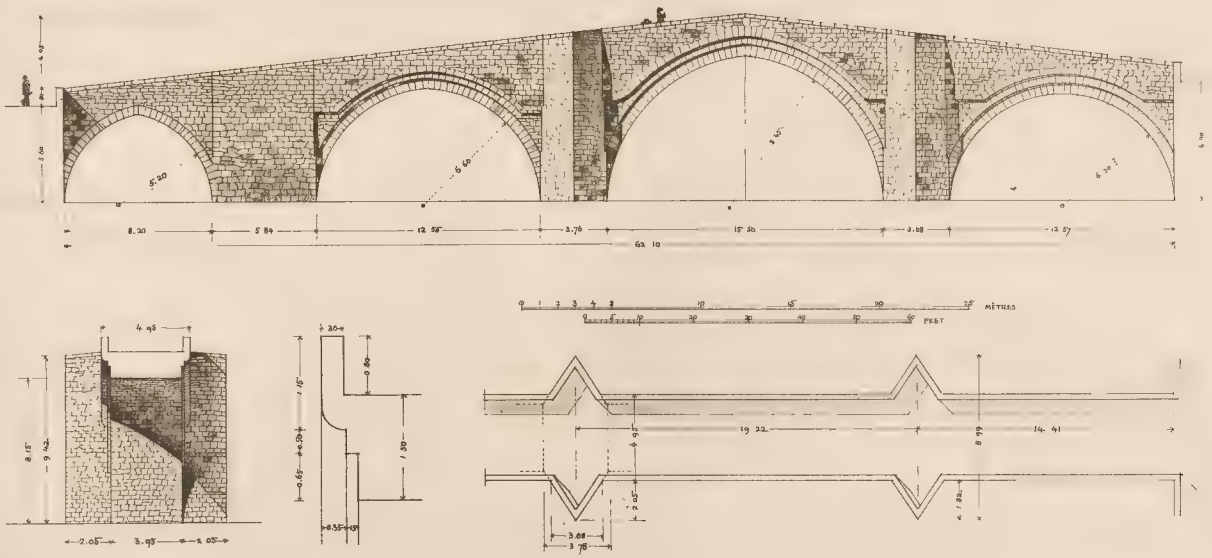
(1) Henry Affre: "Simples Récits sur Espalion" (1850); "Lettres à mes neveux sur l'histoire de l'arrondissement d'Espalion" (1858).

(2) The plan of this pier, at water level, measures 5.84 by 4.40 meters.

(3) It would further seem that these centers are 20 centimeters above mean water level.

ESPALION (AVEYRON)

BRIDGE ON THE LOT.
(XI TH CENT)



flat band 60 centimeters wide, flush with the face of the wall. It is surmounted by a rectangular member, 50 centimeters high with a projection of 15 centimeters, which is in turn crowned by a further projection of 50 centimeters, adjusted to the first in the form of a quarter round. A study of the section shows that this last projecting member has been utilized to set the face of the parapet wall beyond the face of the bridge below. This condition is probably the result of some alteration intended to widen the roadway, which seems the more probable since the stonework above this moulding is not in any way bonded in with that of the piers, as is the case with the arch stones in the flat band below [1]. The way in which the moulding above follows the curve



of the arches at Espalion and then returns horizontally against the piers is again similar in handling to that of the beak-like moulding in a similar position on the bridge of Valentré.

It seems our sad duty to comment on the utter neglect shown in the present condition of the stonework. The joints in particular seem to have suffered : only those that come in contact with the water having been pointed. Considering the fact that it is one of the oldest bridges of France, and because of character and location so well worth preservation, it certainly seems as if it might have been better treated. Placed as it is in a town lacking anything notable architecturally, and where the general tone of the buildings is the harmonious gray that the kindly hand of time and circumstance has achieved, the vigorous lines and good proportions of this bridge would in themselves bring a note of refreshing interest, which is only enhanced by the glowing color of its red sandstone in contrast with its rather drab surroundings.

(1) Comment of Monsieur de Dartein.



AN OLD BRIDGE AT CHALONS-SUR-MARNE
FROM THE WATERCOLOR BY S. CHAMBERLAIN



THE BRIDGE AND THE CITY OF CARCASSONNE

PONT ST. BÉNÉZET ON THE RHONE AT AVIGNON (VAUCLUSE)

What a pity that we should not be able to see this truly great bridge in its completed form! Even ruined, as it stands today, its four remaining arches still add a note of tragic interest to the view from the Rock of the *Doms* looking toward the Valley of the Rhône.

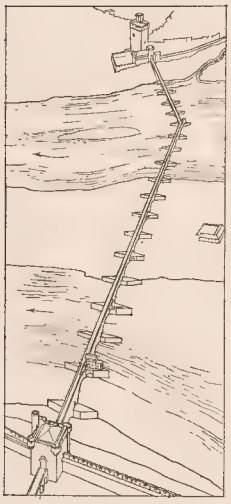
Authorities seem to agree that the bridge was started in 1177 and took ten years to build. Its construction was carried out by the religious order of the Frères Hospitaliers Pontifes[1], an association founded at Maupas in 1164, with the purpose of aiding in every possible way those who were interested in the navigation of the rivers as well as those who dwelt upon their banks.

According to the legend, a shepherd boy of thirteen named Little Benoit, or "Bénézet", was inspired by heaven to start and direct the construction of this bridge. At any rate it is clear that after having worked at Maupas[2], the brotherhood, of which St. Bénézet became the effective head, undertook and carried to completion the building of this bridge in so thoroughly competent a manner that it might well have resisted until today the devastating effects of time and flood, had it not suffered still more from man's negligence and destructiveness.

Viollet-le-Duc calls attention to the fact that this bridge was the only permanent means of access between the papal possessions at Avignon and the French possessions in Languedoc. The site for such a bridge was therefore

(1) The origin and activities of this order have aroused much and very conflicting comment in relation to which we refer our reader to the American Historical Review of Oct. 1923 : *Altopascio*, a forgotten Order, by Ephraim Emerton.

(2) Maupas is near Cavaillon (Vaucluse). See : Recherches Historiques de l'Abbé Grégoire.



The Pont St-Bénézet, after VIOLLET-LE-DUC.

important, and was chosen at a point where the Rhône, as it passes through Avignon, flows in two branches around the Island of Barthelasse. These branches reunite about two kilometers down-stream from the Rock of the *Doms*, before the Durance joins the Rhône. Bridges were first built, if we accept Gauthey's statement, connecting the east and west shores with the island, these bridges being approximately perpendicular to the direction of the current. Later, a connecting link of eight arches was built between the two branches so that the road-way might be raised above flood water from shore to shore. These three sections were not in line with one another. Between them they gave a total length of 900 meters from shore to shore.

The position of the bridge in its relation to the direction of the current is worth close study. Where it crossed the wider branch (on the side away from the town) it is obviously not at right angles to the river. Furthermore, the change in the direction of the bridge occurs, not where we might expect it, on the island, but in mid-stream, about a third of the way across if we measure on the inside of the curve. A similar disposition marks the great bridge of Pont-Saint-Esprit[1]. Viollet-le-Duc believes that this was done deliberately in both cases in order that the obtuse angle thus formed might the better resist the force of the current. When we realize that floods raising the river level 5 meters above normal are of frequent occurrence in this region, such an explanation does not seem at all improbable.

The story of the events that reduced the bridge to its present state is one of vandalism and neglect. Two hundred years after its completion, in 1385, Boniface IX destroyed one of the arches in order to ensure his own safety. Only twenty-five years later the inhabitants, disliking the Spanish garrison maintained by Benoit XIII, blew up the tower at the bridge head. In 1418, having decided to repair the damage, the arch was replaced, but the work being badly done, it collapsed in 1602. Unbalanced without the missing arch, three adjacent arches shortly gave way, followed by two more in 1633. Further damage resulted in 1670, when the river having frozen over, the melting ice produced more destruction, resulting ultimately in the noble remnant that we see today.

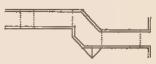
(1) This bridge is located about 40 kilometers up-stream from Avignon, a little below the junction of the river *Ardèche*.



THE PONT BENEZET AT AVIGNON

It seems probable that when the bridge was first built it contained no defensive features, having been intended by its builders merely as a means to facilitate passage from one side of the river to the other. Indeed at this time it did not cross any disputed frontier, for the kings of France on the right and the counts of Provence on the left lived in perfect understanding as to the ownership of the shores and islands. This condition underwent a complete change in 1290 when Philippe le Bel, at the time of the marriage of his cousin with the daughter of the king of Sicily, agreed to turn over his sovereign rights to Avignon to the House of Naples. In order to mark more clearly his control of the right bank and the islands, he erected in 1307 the tower at Villeneuve-lez-Avignon. This was nothing less than a fortress, and absolutely controlled access to the bridge. A little later, when Avignon became the property of the Popes, Clement VI in his turn took a similar step, and built a second tower on the left bank. Thus the worthy purpose of the original builders was entirely lost sight of, and access from side to side could only be had with the greatest difficulty.

While we have spoken earlier of the bridge having been originally designed without any defensive features, it is only fair to call attention to a characteristic that may have been effective for defensive purposes even if not built with this in mind. The bridge is only 4.07 meters wide between parapet walls, having been intended for foot and horse traffic rather than vehicles. Even this limited width is reduced to a mere 1.50 meters before the little chapel dedicated to St. Nicholas, the patron of those who travel by water. Was this excessive narrowness merely the result of conditions, or was it, as Mr. A. Choisy (1) believes, deliberately done to prevent a charge of horsemen or to slow down rapidly marching troops ? Certain bridges in Corsica, which have a sudden break or change of direction in plan, were also, according to Mr. Choisy, designed for such a purpose.



We appear to be justified in believing that the portion of the bridge remaining is a true indication of what previously existed; in other words, that the alternation in the design of successive bays was characteristic of the entire structure. Thus while the arches, which are three-centered and slightly stilted, are approximately uniform with an opening of from 31 to 34.80 meters, and a rise of from 10.75 to 12 meters, the piers show two alternative arrangements. These piers are about 7.70 meters thick and 30 meters long, terminating both up and down-stream in triangular break-waters. Above these break-waters, in one instance we find a single arched opening to aid the passage of flood waters, while in the other we find three, as well as the curiously contrived cut-off

(1) *Histoire de l'Architecture*, vol. II, p. 564.

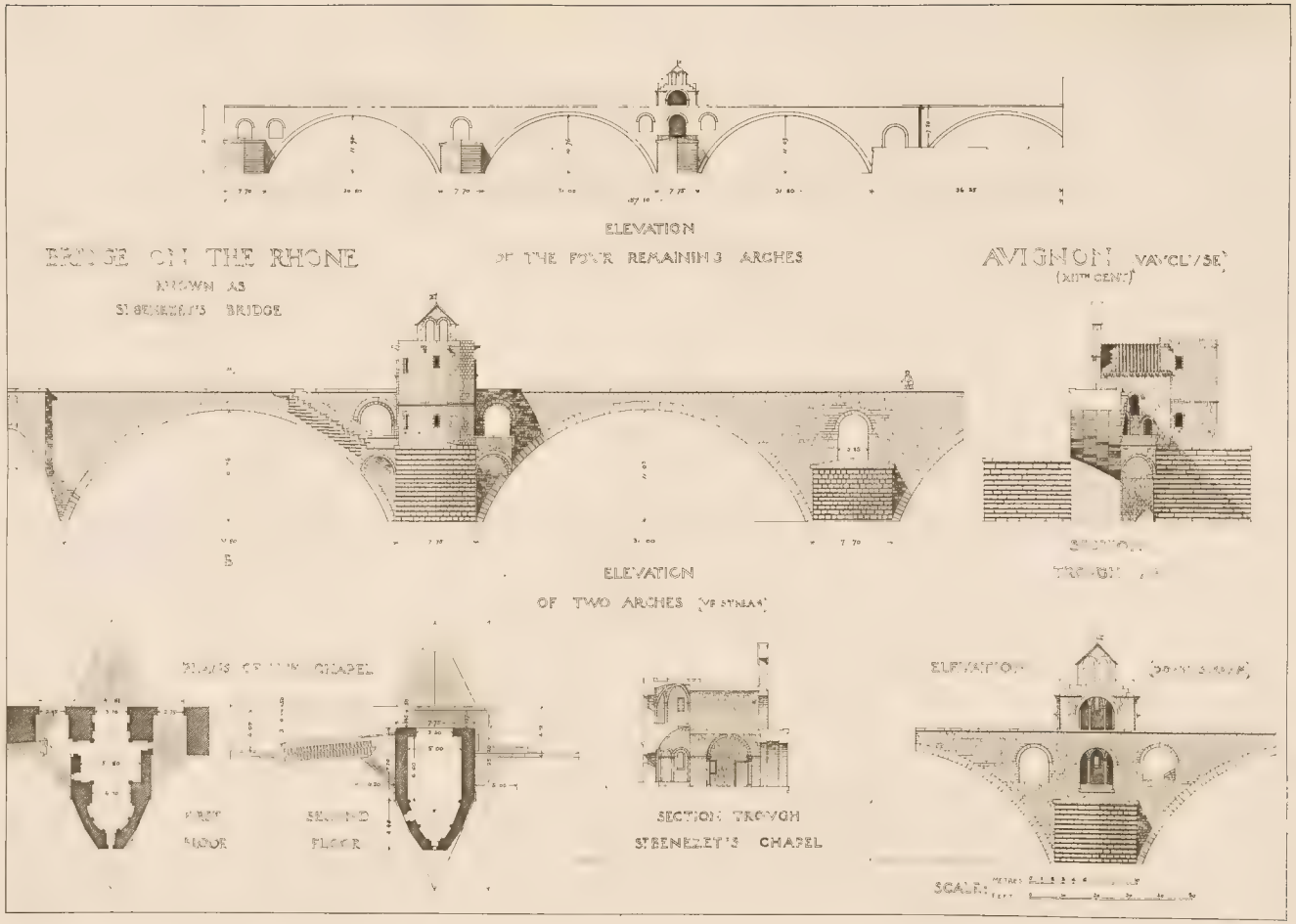
angles (trompes) which have come down to us in perfect condition, beside the picturesque little chapel, with its corbelled stairway leading from the roadway to a level 4.50 meters lower.

It remains only to call our reader's attention to the construction of the

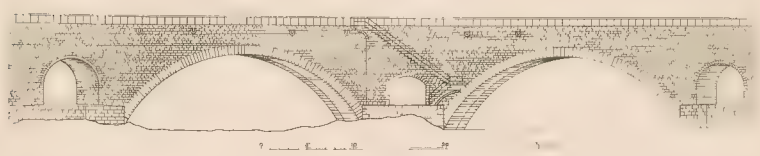


arches, which, we find, have a striking characteristic in common with the Roman aqueduct of the Pont du Gard, only 20 kilometers away. Each arch is made up of four independent (1) rings, the space between being merely filled in flush with the face of the intrados. The bridge of Pont-Saint-Esprit, to which we have

(1) We have used the word *independent* advisedly for M. Morandière (See his : *Traité de la construction des ponts et viaducs*) has found no bond whatsoever between the first two arches, only one between the second and third, and a few between the third and fourth.


ELEVATION
OF THE FOUR REMAINING ARCHES
BRIDGE ON THE RHONE
KNOWN AS
ST BENEZET'S BRIDGE
AVIGNON (VAUCLUSE)
(XIITH CENT.)
ELEVATION
OF TWO ARCHES (UPSTREAM)
PLANS OF LOWER CHAPEL
FIRST FLOOR
SECOND FLOOR
SECTION THROUGH
ST BENEZET'S CHAPEL
ELEVATION
SCALE:

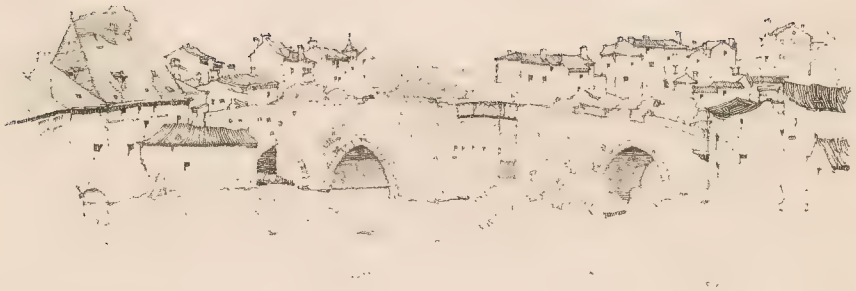
already referred, has this same characteristic, and although built in 1265 under the direction of the Abbé of Tensanges by the Frères Hospitaliers Pontifes, its 22 arches remain standing today, and ensure passage from side to side of the Rhone over a structure which has a total length of 1.000 meters.



Elevation of two arches of the bridge at Pont-Saint-Esprit

Even mutilated as it stands, the bridge of St. Bénezet makes an unmistakable appeal to the appreciative traveller. There is a soaring grace in the lines of its arches which, together with the beauty of the little chapel, give a charm to this sturdy remnant of the past that is irresistible.





TWO VIEWS OF THE BRIDGE AT THOUARS

FROM THE PENCIL SKETCHES OF L. C. ROSENBERG & S. CHAMBERLAIN



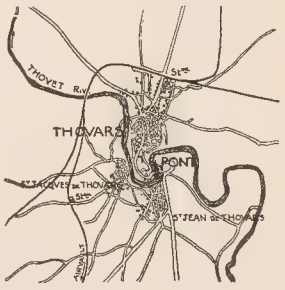


THE BRIDGE AT SEMUR

BRIDGES IN THE VALLEY OF THE THOUET
THOUARS, AIRVAULT, ST-GÉNÉROUX, PARTHENAY

The little river Thouet, which is about 120 kilometers in length, crosses the department of the *Deux-Sèvres* before entering that of the *Maine-et-Loire;* and after following for some time an easterly course through Parthenay, turns to the north, keeping this general direction until it empties into the Loire not far from Saumur, below St. Florent. The country through which it flows is not mountainous, but it would be a mistake to suppose that it is monotonous. On the contrary, it abounds in picturesque sites, and no less than four interesting examples of architecture are to be found in the central part of its course lying between Thouars and Parthenay. If we except the bridge of Vernay, there are, it is true, no structures of any considerable importance, nor any that, taken singly, bear a distinctly decorative character, but they are admirably situated, and the landscape, or the constructions of which they form a part, give them a peculiarly fine setting. Let us ascend this sinuous little stream, starting from Thouars. We must stop twice on the way before reaching Parthenay, first at St. Généroux, then near Airvault where the old bridge of Vernay stands.

The little town of Thouars is an important place in the department of *Deux-Sèvres.* It climbs up the slopes and onto the summit of a fairly high hill whose base is washed by the Thouet. After a sweeping curve, this enterprising stream passes through a narrow gorge, and then resumes a quieter course towards the north. Thouars is an ancient feudal town, from the Xth century the seat of a viscount dependent upon the Comté of Poitou. It is for this reason that in the course of the following centuries it belonged successively to French and to English; but is was the latter who finally established themselves there and made it one of the most strongly fortified places of that region, up to the time when it was retaken by Du Guesclin. Almost directly afterwards it was made into a duchy for the La Trémoille family, who built a castle there.



Our drawings show the vigorous simplicity of the bridge which crosses the Thouet here. It consists indeed of little more than solid points of support between the pointed arches, but the mass is on the whole harmonious, and lacks neither character nor breadth. A treatment that is common to this and



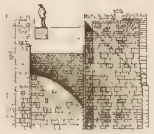
St-Généroux, by L. C. Rosenberg

to many other mediaeval works is the abrupt removal of the floor of the bridge between two of its piers, and replacing it by a light foot-bridge, easily destroyed in case of unexpected attacks. The resultant effect seen with an old mill on one side and the ruins of the entrance-gate on the other, is agreeably picturesque.

SAINT HENEROUX (LES-BAINS-HAUTES)

XIIITH CENT.





SECTION
TROUGH
AB



SCALE:



No less agreeable is the aspect of the bridge of St. Généroux, connecting the two parts of a modest village built on both sides of the river. The bridge consists of three semicircular arches flanked by two pointed arches. According to tradition it dates from the XIIIth century. As in so many other mediaeval bridges, the piers consist of triangular cut-waters, on the up-stream side, which become only slight rectangular projections down-stream. At the level of the narrow road-way, the extra width given by the piers is used to facilitate passing, and one of them is partly occupied by a very simple cross, which is shown in detail in our drawing. If any of our readers should be tempted to visit this old bridge, and indulge themselves by yielding to the temptation, they will be well repaid. Its dimensions are not imposing, nor has it any particular claim to architectural merit, but in the subtle relation between its gently curving arches and its sturdy piers, lies the magic of a charm that is



Airvault

only enhanced by the tree-grown banks, and the constant passing of gentle peasant folk with their mixed herds of sheep, goats, cattle and dogs.

As to the bridge of Vernay, which owes its name to the Chateau de Vernay opposite the village, on the left bank of the Thouet, to which it gives access, it is a historical monument of respectable age, since it is a Romanesque work of the XIIth century, and perhaps even of the end of the XIth. It shows homogeneous construction with its eleven semicircular arches, each one strengthened by three projecting ribs. Its relatively slight elevation above the level of the water, the unusual use of these ribs, the rather heavy outline of its cutwaters, combine to give it a special character easily recognizable in the drawings. It is



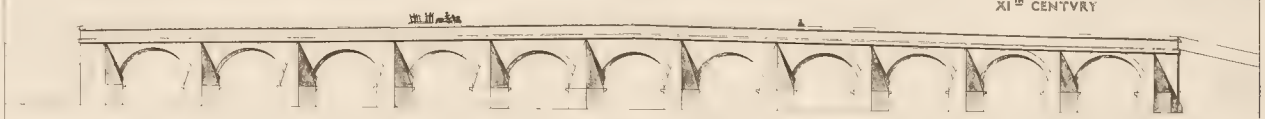
probable that the construction of the Vernay bridge is due in part, if not wholly, to the Augustine monks of Airvault *(Aurea Vallis)*, the church of the district, which is situated a few hundred yards from the river, being in fact the old abbey.

At the time of the wars of the Revolution, the stronghold of Thouars having been occupied by the Vendéens, two of the arches of the Airvault bridge were destroyed and subsequently replaced by a wooden foot-bridge. Almost a century later it was thought worth while to restore this monument to its original condition; the two arches were rebuilt, but, through negligence or incapacity on the part of the architect who had charge of the work, the restoration gave rise to much grave criticism, traces of which are to be found in the reports of the sessions of the *Conseil Général des Deux-Sèvres*, 1886-1888. The cornice of the bridge had been changed, and the slope altered in such a way as to create a difference of level amounting to an abrupt sill in the

AIRVAULT DEVX-SEVRES

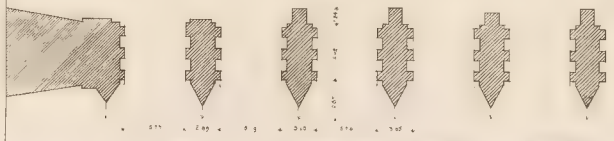
BRIDGE ON THE THOVET

XITH CENTVRY

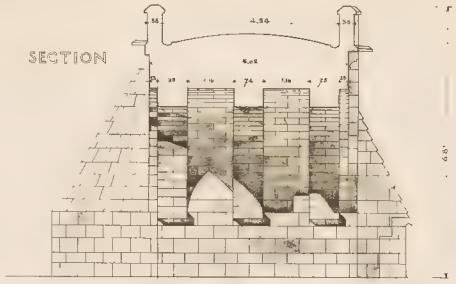


ELEVATION (VP-STREAM)

PLAN

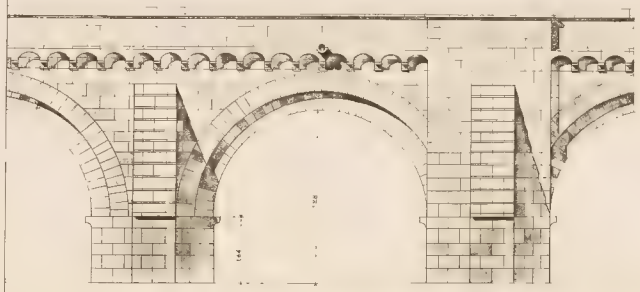


SECTION

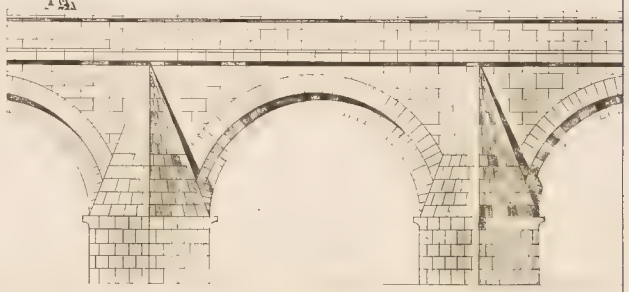


SCALE FOR PLAN AND ELEVATION

SCALE FOR SECTION AND DETAILS



DETAIL OF AN ARCH (DOWN-STREAM)



DETAIL OF AN ARCH (VP-STREAM)

middle of the road-bed, which interfered materially with the traffic. The architect was dismissed. The injury, at present remedied, does not prevent us from getting a good impression of this important monument, — a type of mediaeval construction which is far from usual, and which for that reason commands our attention.

At Parthenay, quite a distance farther up-stream, it is only the picturesque that we can hope to find. But from this point of view we should find much to satisfy our expectations. The ancient capital of Gâtine, it has preserved traces of its past, notably perhaps, in its XIIth and XIIIth century ramparts, although its situation presents many attractive features. On the north and west the Thouet flows around the low hill on which the town stands. It must have gradually worn its way through the comparatively deep ravines before passing, at the entrance to one of them, between the two spurs of land, on one of which stands the citadel, and on the other the old chateau. At this point the river is spanned by a bridge of some age, which is nothing remarkable in itself, but which composes most picturesquely with the Gate of St. Jacques and its crenellated towers. The last arch towards the town was replaced by a drawbridge, which has since disappeared. The general setting of this little bridge is so appealing that we might well do worse than to finish at Parthenay the wanderings we have been tempted to make in this beguiling region, for there is much besides these bridges to interest the sympathetic traveler in Poitou.



The bridge at Parthenay



THE BRIDGE AT VILLENEUVE-SUR-LOT

BY L. C. ROSENBERG



THE BRIDGE AT ORTHEZ

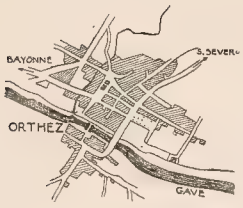
BRIDGE AT ORTHEZ (Basses-Pyrénées) ON THE GAVE DE PAU

The bridge which connects Orthez with its suburb on the other side of the Gave de Pau is one of those interesting old fortified bridges so perfectly typified by the bridge of Valentré at Cahors.

The present aspect of this bridge has much charm, even though lacking some of the picturesque elements that marked its primitive state. Originally there was one major arch of 15 meters or so in span, between two piers of about equal size, on each of which was a defensive tower. On the right bank, or side toward the city, were two other arches of about half the size of the main arch, whose piers rested on a rocky ledge appreciably above the level of the river. These were useful in augmenting the free-way in time of flood. Perhaps there was even a third arch on this side, as there are evidences of the arch stones; but on the left bank, or side toward the suburb, the stone work was finished off definitely, the passageway being assured by a little wooden bridge which could easily be destroyed in case of attack.

As at Cahors, the exterior walls of the bridge-heads, forming the parapets, were raised to a considerable height above the road-way, thus affording protection so that it was possible to circulate without being seen. On the axis of the main arch a little window was cut, which has now disappeared, but from which, in 1560, the Protestant soldiers of Montgomery hurled into the river the priests whom they had captured during the siege of the town. It is more than likely that even before this date the tower on the left bank had disappeared; at least it does not figure in a representation of the bridge referred to by Mr. Adrien Planté[1] which is said to date from 1589. The wooden

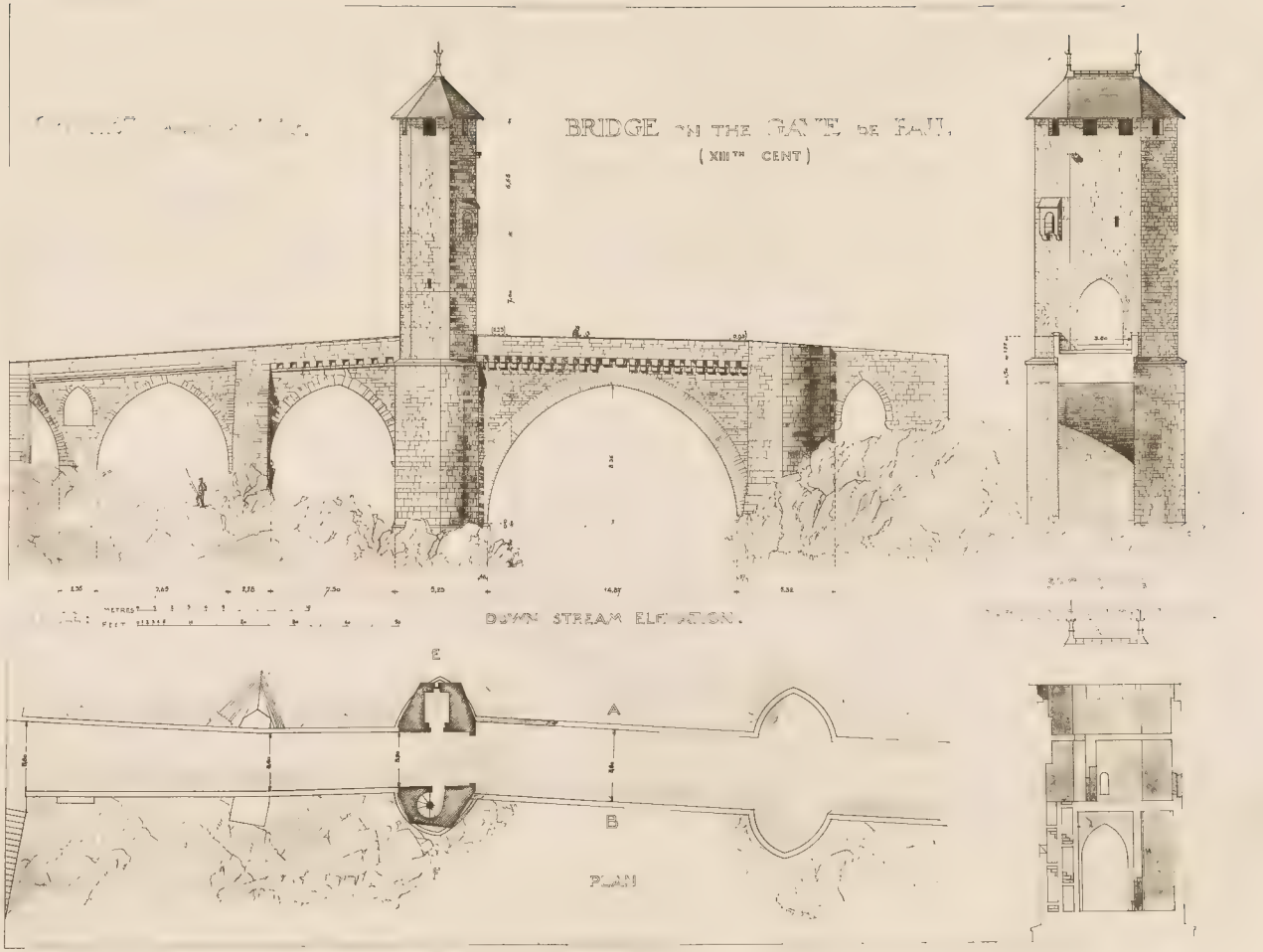
(1) Published in 1892 at Pau on the occasion of a meeting of the *Association française pour l'avancement des sciences*. It refers to an old embroidery of which there is a reproduction in Mr. de Dartein's book.



bridge does not appear either, and seems to have been replaced by a masonry slab, which in our days has been succeeded by a small arch in the character of the others, but only 2.70 meters wide.

The high parapet walls, however, appear in the document mentioned above. They very likely were in existence as late as February, 1814. At this time, in the struggle between the soldiers of Marshal Soult and the English (fifty of the former defended the bridge and tower throughout a day), while an attempt to undermine the bridge failed, the parapets were destroyed and had to be rebuilt. Since then, the road-way has been widened with the help of projecting brackets.

This fine old bridge, which is very similar to that of Sauveterre in the same region, dates well back into early French history. While it has not been possible to establish its exact date, it would seem to belong to the thirteenth century, and very probably replaced an even older bridge.


BRIDGE ON THE GAVE DE PAU.
(XIIITH CENT)
DOWN STREAM ELEVATION.
PLAN
A
B
E
F

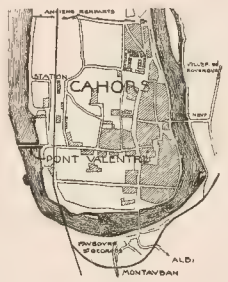


THE PONT VALENTRE AT CAHORS

THE FORTIFIED BRIDGE AT CAHORS, ON THE LOT

No more perfect example of a fortified bridge exists within the limits of France than the Pont Valentré as we see it today, practically intact, and telling so strikingly the graphic story of the early years of the fourteenth century when it was built[1]. It expresses unmistakably the wide divergence between our modern idea of a bridge as a means of facilitating circulation, and the Mediaeval conception of it as a mere outlet so devised as to preclude access when desired. Certainly, at a time when artillery hardly existed, the task of entering Cahors was made all but impossible (for unwelcome visitors). Yet the structure that so skilfully served this purpose is a thing of rare beauty as well, and shows that the Gothic builder had as complete a mastery of military as of religious architecture.

So nearly completely does the river Lot, a tributary of the Garonne, envelope the town of Cahors, that it is only from the north that the town can be approached without crossing the river. But, as important lines of communication lead to the south, from Limoges, towards Agen, Montauban or Albi, as well as to the east and west, practically everyone entering or leaving the town found himself forced to cross the Lot. Two bridges, very similar in character and both connected with the town walls, dominated from their commanding position upon the main east and west roads, both the river and the surrounding country. It is the one to the east of the town that alone remains, restored with judgment and taste, and named, not as has been supposed after the presumed architect, but because of its position — *val-entrée* — at the entrance to the valley.



As we look down-stream the bridge forms the center of interest between the low-lying roofs of the town to the right and the steep hills rising abruptly from the river to the left. On the axis of this picture rises the central tower of the bridge to a height of more than 40 meters above the river, flanked on

(1) It was built between the years 1308 and 1355 at the order of Raymond Panchelli, who was bishop of Cahors during the first twelve years of the XIV th century.

either side by three major and one smaller arch, which carry the roadway some 16 meters above the Lot. At either end of the bridge is another tower, separated from the shore in each case by the smaller arch referred to above. The entrances to the bridge were further protected on both sides by other structures which have since disappeared, but of which sufficient evidence remains to permit the presentation shown in our drawings, from material gathered in the library of the *Monuments Historiques.*

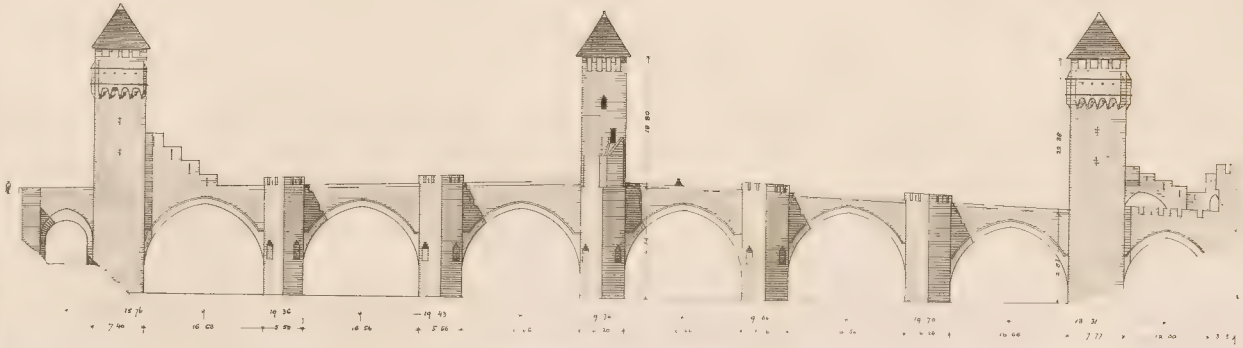
So carefully was the bridge built that hardly any eccentricities exist that call for comment. With one variation of 10 centimeters the main arches are all 16.50 meters wide; their rise varies from 13.70 to 14.15 meters, and all are two-centered or pointed in form. On the inner surface of these arches, at about the impost, are five beam holes for carrying the centering. On the up-stream side the piers are protected by triangular cut-waters with a projection of six meters, while down-stream they have a rectangular projection of only 85 centimeters. These dimensions, together with an over-all width for the bridge of 5.90 meters, give a total length of 12.75 meters for the piers.

These piers have one peculiarity that is noteworthy. At 80 centimeters from the up-stream face of the bridge, there has been built in each pier a passageway 1.20 meters wide, which runs parallel to the bridge, completely through the pier. Three beam holes, in connection with these openings on the face of the piers, indicate that with the help of wooden platforms from pier to pier, a means of communication was thus maintained during the construction of the bridge.

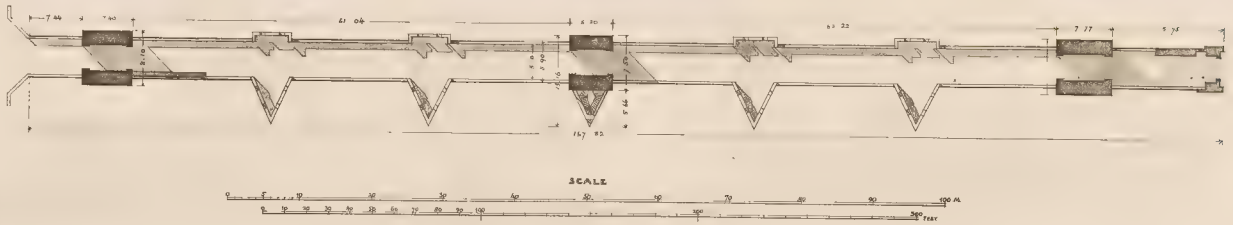
With a variation in width of from 5.50 to 6.25 meters, the piers rise vertically to the level of the roadway, where their area is utilized to give passing room. Each face is provided with crenelations above the parapets. On the central pier, as we have noted, is a lofty tower, whose masonry walls rise almost 19 meters above the level of the roadway. Judging from the lack of defensive features it was intended primarily as a watch tower, and had three stories. The two other towers, which are practically identical, have various points of interest. They are four storied and, as was the case with the central tower, are reached by outside staircases, in one case contrived as part of the parapet on the up-stream side, and in the other carried on a flying buttress, but in both cases protected by crenelations that follow the rise of the steps. The first floor rests upon the vaulting over the passageway across the bridge. The flooring of the other stories is carried on wooden beams resting on corbels; and communication from floor to floor was maintained by simple wooden ladders. Every possible defensive device was provided: the space for the cross bow men was arranged in niches provided with vertical slits only 6 centimeters wide, crossed twice horizontally. From the third floor every

CAHORS (LOT)

PONT VALENTRÉ
(XIVTH CENT)



ELEVATION AND PLAN



SCALE

sort of missle could be dropped upon those beneath, and a similar arrangement existed in the vaulting over the passageway. The topmost floor under the roof framing is provided merely with crenelations.

The bridge has in no way suffered from its restoration, which has been handled with the greatest discrimination, so that the resulting structure typifies,



both by its simplicity and by the beauty of its proportions, the best period of Gothic architecture. The fact that this architecture found its most developed expression in religious buildings does not in the least diminish the value of work performed for civil or military purposes, rather the reverse. In fact, regardless of period or style, no one could fail to appreciate the qualities of this bridge. An interesting silhouette, combined with a nice balance between solids and voids, gives to the whole a quality of distinction that is further enhanced by the well-studied curves of the pointed arches, the perfect suita-

bility of the forms employed for defensive purposes, and by the bold simplicity of the contrasting horizontal and vertical lines.

Nothing seems to have been sacrificed to decorative effect, and yet what an essential decorative composition has resulted! Only one moulding, of a markedly nervous profile, is permitted to tempt the eye from the austere lines of military necessity. The moulding in question follows the line of the extrados of the arches, except where it returns horizontally against the faces of the piers. It is perhaps worth while to note here that the little *chatelet* which precedes the entrance to the bridge on the left hand side, as shown on our drawings, does not exist today, but is based upon a restoration made by Mr. Paul Gout[1].

For those who have seen the bridge, learned its life, studied its character, the preceding description seems an utterly inadequate picture of the part that it has played in the life of the town that it serves. No description can give an idea of how constantly its towers dominate the view; how intimate and essential a part they play in the everyday existence of the towns-folk; what an added beauty the curving reflections of the arches give to the graceful lines of the bridge, and how pleasingly the rich cream color of the stonework mingles with the green of the trees on the left bank; and yet this, and much more, is needed to give you the whole story of this ever-living presence, and our advice to one and all is to go and see the Pont Valentré for themselves.

(1) Histoire et description du Pont Valentré à Cahors (Lot), par M. Paul Gout.





THE BRIDGE AT MONTAUBAN

THE BRIDGE AT MONTAUBAN (Tarn-et-Garonne) ON THE TARN

Even as we see it today, stripped of many features that must have originally greatly added to its interest, this bridge is impressive.

In the first place, it is 200 meters long, and built of brick. Its seven pointed arches carry the roadway at a height of about 19 meters above the river. Six of these arches have the same span, *i.e.* 21.50 meters; but the seventh, which is nearest the town, is a meter wider. The piers, which are eight meters thick, have triangular break-waters both up and down-stream, while above the break-waters the tympana are pierced by arched openings, to add to the free-way in times of flood.

These are the essential elements of the bridge as we see it today. It was started, so far as we can learn, in 1311, and carried to completion under the direction of Etienne de Ferrières and Mathieu de Verdun. The structure that was thus brought into being some six hundred years ago, in addition to the imposing dimensions that we now admire, carried defensive towers at each end, linked together by high (1.35 meter) parapets which included narrow sidewalks and also crenelations[1].

The silhouette of the bridge gained still further interest from a chapel that was built upon the break-water of one of the central piers. This was dedicated to Ste. Catherine, and could be reached not only from the road-way but also by means of a circular stair in the pier itself, leading to a little door at water level.

All these features so essential at the time the bridge was built and sus-

(1) At least the bridge is so represented in a bas-relief of the middle of the XVIth century. The bridge across the Adige at Verona has a similar arrangement although the road-way is narrower.

ceptible of adding so appreciably to the interest of the bridge in our own time, have, alas, disappeared. It was in 1828 that, in an effort to gain a meter or so in width, these interesting parapets were removed and replaced by projecting stone slabs, held up by corbels and crowned by an iron railing whose only redeeming feature is its elemental simplicity. The towers had long since ceased to exist. One of them, that near the town, only lasted until 1663, and the other was destroyed in 1701 to make room for a monumental entrance-way erected to celebrate the Peace of Ryswick. This latter construction was in existence up to fifty years ago, when it yielded in its turn to the demands of traffic; and with it the little chapel also disappeared.

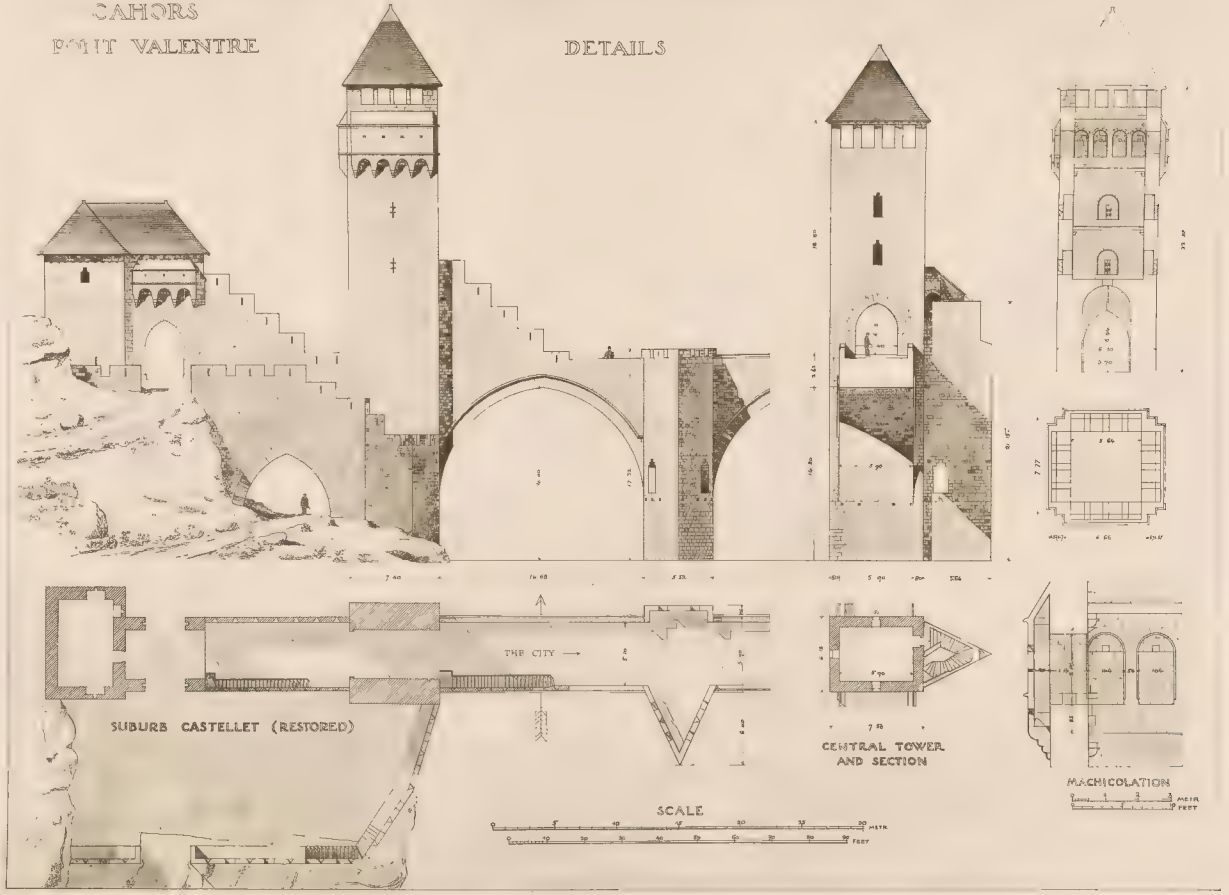
About the openings in the center of the piers, to which reference has already been made, there is a highly specialized and most carefully detailed construction for the distribution of the thrust of the arches, that is worthy of most careful study and that is clearly portrayed in the section accompanying our measured drawings. A more skilful contriving of balanced thrusts, in order that the essential needs of the construction might be met without imposing unnecessary weight upon the carrying arches, could hardly be devised than appears at N and M, and at A and B in our section drawings. No Gothic cathedral shows a nicer interpretation of structural needs.

Having called attention to this highly intricate and most masterly computation of weights and thrusts, little remains that in especially noteworthy. Yet to anyone who has seen the bridge it leaves an impression of fine scale, imposing mass, well proportioned arches, and structural stability that is lasting. A bridge that can lay so strong a hold on the memory when stripped of every iota of decoration, must have sterling qualities. We way well wonder, in comparison, what impression the bridge of St. Benezet at Avignon would make without its chapel, of that of Valentré at Cahors without its three towers. Yet, stripped as it stands of former glories, the patine of the centuries has dealt kindly with its honorable scars, and with the help of the mellow brick work, has left us a thing as lovely in color as it is noble in proportions.

CAHORS

PONT VALENTRE

DETAILS



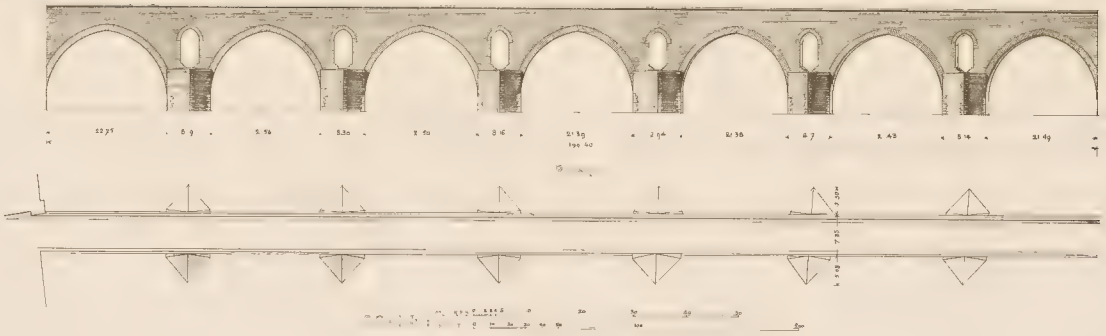
MONTAUBAN

TARN ET GARONNE

BRIDGE ON THE TARN

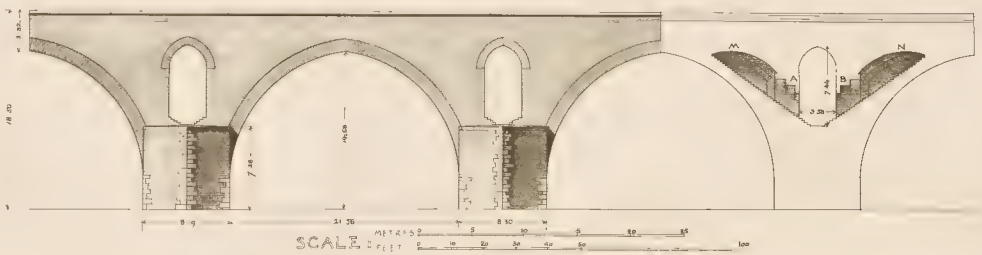
XIV.TH CENT.

GENERAL ELEVATION



DETAIL OF ARCH

SECTION THROUGH PIER



SCALE



THE BRIDGE AT CERET

BRIDGE AT CÉRET (Pyrénées-Orientales) ON THE TECH

At only a short distance from the Spanish frontier is located the bridge of Céret, undoubtedly one of the most striking as well as one of the most unusual bridges of France. It is on the line of the national highway from Perpignan to Prats-de-Mollo, just where this road, coming from the little village of Le Boulou, crosses the Tech before entering the town of Céret.

To the interest that a great semicircular arch of over 45 meters in span would naturally attract, is added the remarkable boldness and lightness of its construction. The unusual silhouette gains an added interest from the arched openings that pierce the solid approaches and thus lighten the load upon the sides of the great arch.

While rumor has it that this bridge is of Roman origin, there seems no doubt that its construction belongs definitely to the first half of the XIVth century, contemporaneous with that of the fortified bridge at Cahors. It is quite possible, however, that the existing bridge replaced a Roman structure of similar appearance. The character of this bridge would seem to justify such an hypothesis, and we should further remember that the valley of the Tech was the line followed by the Roman road from Nîmes and Elne (*Elena*) towards Spain, which crossed the Pyrénées either by the Col d'Ares, the road that Cæsar probably followed, or by the Col de Perthuis, over which Hannibal's army is supposed to have passed.

Local archives enable us to establish a fairly definite date for the construction of the existing bridge. It appears to have been built during the reign of Sanche and Jayme II, kings of Majorca, probably between the years 1324 and 1340, at the expense of the town and of those dwellers in the upper valley who had an interest in seeing it built (1). The work was carried out under the direction of the consuls of Céret, and the bridge was crossed, if not inaugurated as well, in 1349 by Pedro IV, king of Aragon and brother-in-law of Jayme II.



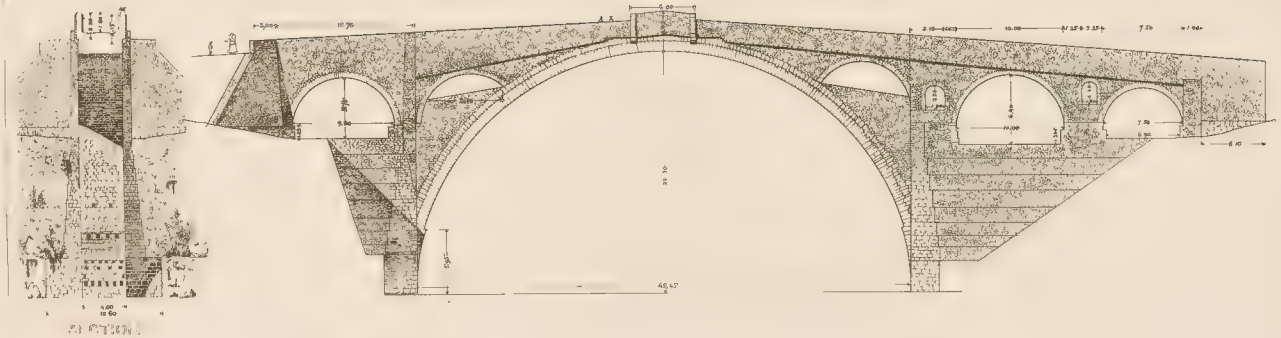
The arch-vault of this daring piece of work is built of two entirely separate arches. The first, at the intrados, is of a uniform thickness of 95 centimeters; the second varies in thickness from 37 centimeters at the crown to 50 centimeters at the sides. The arch, as originally built, was very likely semicircular; but, following the removal of the centering, and because of various accidents, the crown has dropped about 40 centimeters. The rise is now 22.70 meters, and the span 45.50 meters.

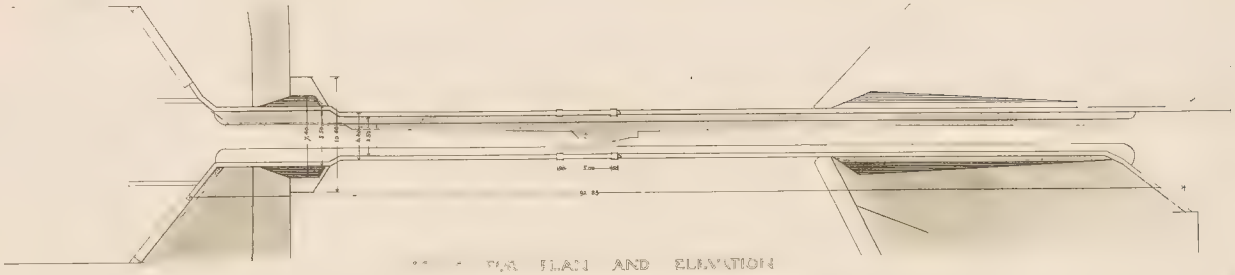
The condition of the bridge has been a source of anxiety for some time past. Undoubtedly the principle of entire independence between the vault and the arches (an idea of Roman origin) has given unparalleled elasticity to this

(1) Mr. Séjourné, whom we have to thank for this information, indicates that several legacies were also left between 1324 and 1334 to aid in the construction of this bridge.

CÉRET, PYR. ORIENTALES

BRIDGE ON THE TECH
(XIVTH CENT.)





PLAN AND ELEVATION

METRES

FEET

enormous stone arch. But either because of defective stone work, of for some other reason, the elements of the vault have lost a certain degree of cohesion so that deformations that are easily apparent to the naked eye have occurred, particularly on the up-stream face. Thus the elasticity has become a risk rather than an advantage.

In the early part of the XVIIIth century it was noticed that the passing of artillery shook the bridge in a serious manner, and again in the following century, in spite of precautions, that a carriage crossing at any speed caused the bridge to tremble to an unreasonable extent. By 1750 cracks appeared, and in the same year the wall continuing the bridge-head on the down-stream side toward Le Boulou collapsed, followed twelve years later by that on the up-stream side. Both were replaced by angle wing walls.

In an effort to solidify the structure it was decided to fill in, at least in part, those arched openings which had been originally created to relieve the load on the sides of the arch. The appearance has suffered in consequence, and Mr. Séjourné comments on the futility of this proceeding which adds to the burdens of the arch, at the same time damaging the appearance of one of the oldest and the finest monuments of France.

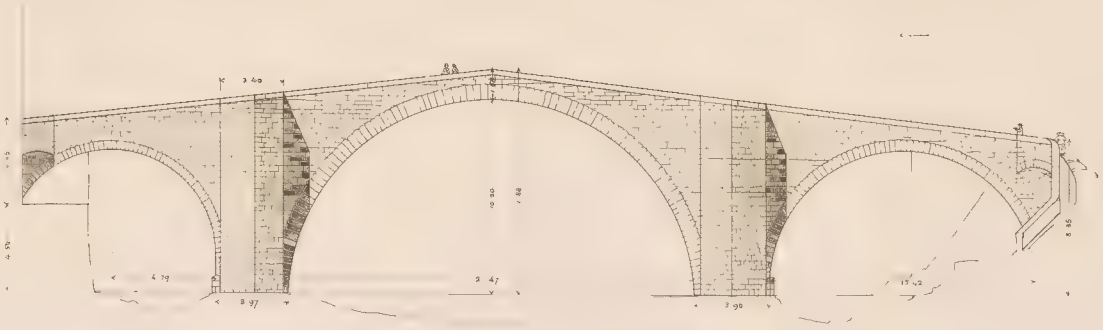
THE BRIDGES OF ST-AFFRIQUE, OF VIENNE, OF NYONS AND OF CLAIX

We cannot say our last word about the bridges of the Middle Ages without speaking of three structures which, while not of first importance, are nevertheless of so striking an appearance that we should fail in our undertaking if we did not call them to our readers' attention. These are the bridges of St. Affrique in the valley of the Tarn, and of Vienne and Nyons in the region watered by the Rhône; and while they obviously are not entitled to detailed comment, they certainly should receive the recognition of the sketches and notes that follow.

Saint-Affrique, a modest *sous-préfecture* in the department of the Aveyron, is situated on a little stream named the Sorgue, whose waters eventually reach the Tarn. Here we find an old Mediaeval bridge of an unusual character. The nature of its architecture, the narrowness of its roadway accentuated by its steeply sloping ramps of approach, combine with its abrupt cut-waters to strongly mark its individuality, at the same time indicating that it is one of the oldest bridges in the district. Exact information is unfortunately lacking as to the precise date of its construction. We know merely that it was in existence in 1368, but the characteristics mentioned above are ample evidence that it must have been built many years before this date.

Its main arch has a span of 21.50 meters, and is flanked by two minor arches of unequal openings, one being 15.40 meters and the other 9.60 meters wide. These dimensions, plus two piers of 3.40 meters each, give the bridge a length of 53.30 meters.

The piers have cut-waters both up and down-stream that are almost identical and that provide, at the level of the narrow roadway, much needed

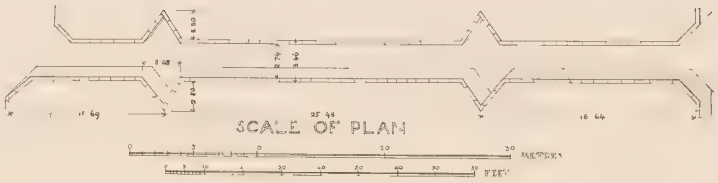


SCALE FOR ELEVATION AND SECTION



BRIDGE ON THE SORGUE AT SAINT AFFRIQUE (AVEYRON)

(XIVTH CENT.)



SCALE OF PLAN

passing space. Not only is this roadway excessively narrow, 2.50 to 2.75 meters between parapets, but in order to climb over the crown of the central arch it has a slope of at least 14 per cent. One other peculiarity is the use of small arches between the bridge and its abutments, evidently used in connection with an effort to facilitate access to the bridge.

Simpler still is the bridge at Vienne. This old town, which in Gallo-Roman times was the capital of a considerable region, and still preserves a charming temple as evidence of its former splendor, is situated on the shores of the Rhône about 30 kilometers to the south of Lyon. At its northern extremity



Bridge on the Gère at Vienne, by Louis Rosenberg

the river receives a small affluent, the Gère, and just at this point, among the old houses that give it so picturesque a setting, we find the single and somewhat flattened arch which we show in our sketch. Its qualities and characteristics are so simple that they call for no further comment.

The Eygues is an affluent of the Rhône which flows into it from the east about 12 kilometers below the bridge of St. Esprit, approximately on a line with Orange. The bridge of Nyons spans this stream in a single arch and is noteworthy both because of its interesting outline, the boldness of its construction, and its age. Even though we cannot be positive as to the date of its construction we know that it was begun after 1351, and finished in the early years of the XVth century, perhaps in 1407[1]. We know further that the

(1) This is the date given by Mr. Séjourné.

master mason who undertook the first stages of the work for 220 florins was a certain Thibault of Nyons. With the laying of the abutments, completed in 1398, a man named Guillaume de Pays undertook the balance of the work for 1.200 florins. Two years later the engineer J. de Beaulieu insisted upon a modification of the centering, which seemed insufficient for an arch of such a span. There is every reason to believe that he was right, and that even the safeguards which he called for were insufficient to meet the requirements, for the crown of the arch gives the impression of a segment of a circle that is out of line, or flattened. Mr. Séjourné calls attention to a similar deformation in the bridges of St. Esprit and Avignon, and we shall see that it is likewise noticeable in the Renaissance bridge at Claix.



The bridge at Nyons, by Louis Rosenberg

There exists, in the embankment on the left side, a little passage with a barrel vault which bears a string course, at the spring of the vault, of a peculiarly Roman character. This is one reason for believing that this fine bridge was constructed upon foundations of a much earlier date, probably contemporaneous with that large group of structures belonging to the Roman period that characterize this region.

At the very summit of the bridge, directly over the crown of the arch, there may still be found remains of an older masonry that have been smoothed off horizontally, and which undoubtedly belonged to a central tower, evidence of whose existence is to be found in old documents. It is said to have been in the form "of a cube six feet square", covered by a little dome, whose purpose, like that of many a similar construction of this period, was "to admit, repel, or check those who tried to pass".

The three bridges that we have just described all belong to the Middle Ages; but we have included one other in this group which, while Mediaeval in appearance, actually belongs to the XVIIth century. This is the bridge of Claix. It was built in the years from 1608-1611, and spans the Drac, about two leagues from Grenoble in the direction of Sisteron. Even though it was built at so much later a date, it closely resembles the bridge at Nyons. Its span, of 46.35 meters, is a few meters greater than that at Nyons, but the curve at the crown of the arch seems too close to the arc of a circle for us not to attribute its flattening to some accident on the removal of the centering, or to some later settlement.

In this case also, thanks to Mr. Séjourné, we know the names of those who were responsible for this bold piece of construction. The first was Bruisset of Grenoble, drowned, alas, during the work. He was succeeded by Jean Albert de la Mure, with whom was associated the carpenter Sallemin. Twelve years after the bridge was finished, a sort of triumphal gateway was built on the left side, ornamented with commemorative inscriptions; but no vestige of this remains.







TWO VIEWS, UP AND DOWN-STREAM, OF THE BRIDGE AT SAINT-SAVIN
ON THE GARTEMPE



THE BRIDGE AT TOULOUSE

THE BRIDGE AT TOULOUSE ACROSS THE GARONNE

This great bridge of Toulouse, because of its dimensions no less than its architecture, is one of the most important in the south of France. It is also one of the most striking of those that span the large rivers, for, as we have remarked elsewhere, the most interesting bridges are more apt to be found on streams of minor importance. Its length is actually in excess of 220 meters between abutments, and its width is nearly 20 meters. There are, furthermore, special and unusual characteristics that attract our attention.

Before commenting on these special features it will be well to place the bridge in its historical setting so that we may feel acquainted with the various vicissitudes through which it has passed. The building of the bridge is accredited to Nicholas Bachelier and to his son. They worked on it from 1543 to 1626. Certain authors even give a date as late as 1632 for the completion of the work. For its embellishment the celebrated architect Mansart erected a triumphal arch at the entrance on the left end. This was retained until 1861. As a consequence of repairs undertaken at about this time, namely 1867, the coping was lowered about 45 centimeters, and an increase of width resulted amounting to 80 centimeters. These repairs enabled the old bridge to withstand the flood of June 1875, which was of unusual violence. It overthrew the bridge of St. Michael up-stream, and down-stream the bridge of St. Peter as well, in addition to causing very serious damage by flooding the entire suburb of St. Cyprien.

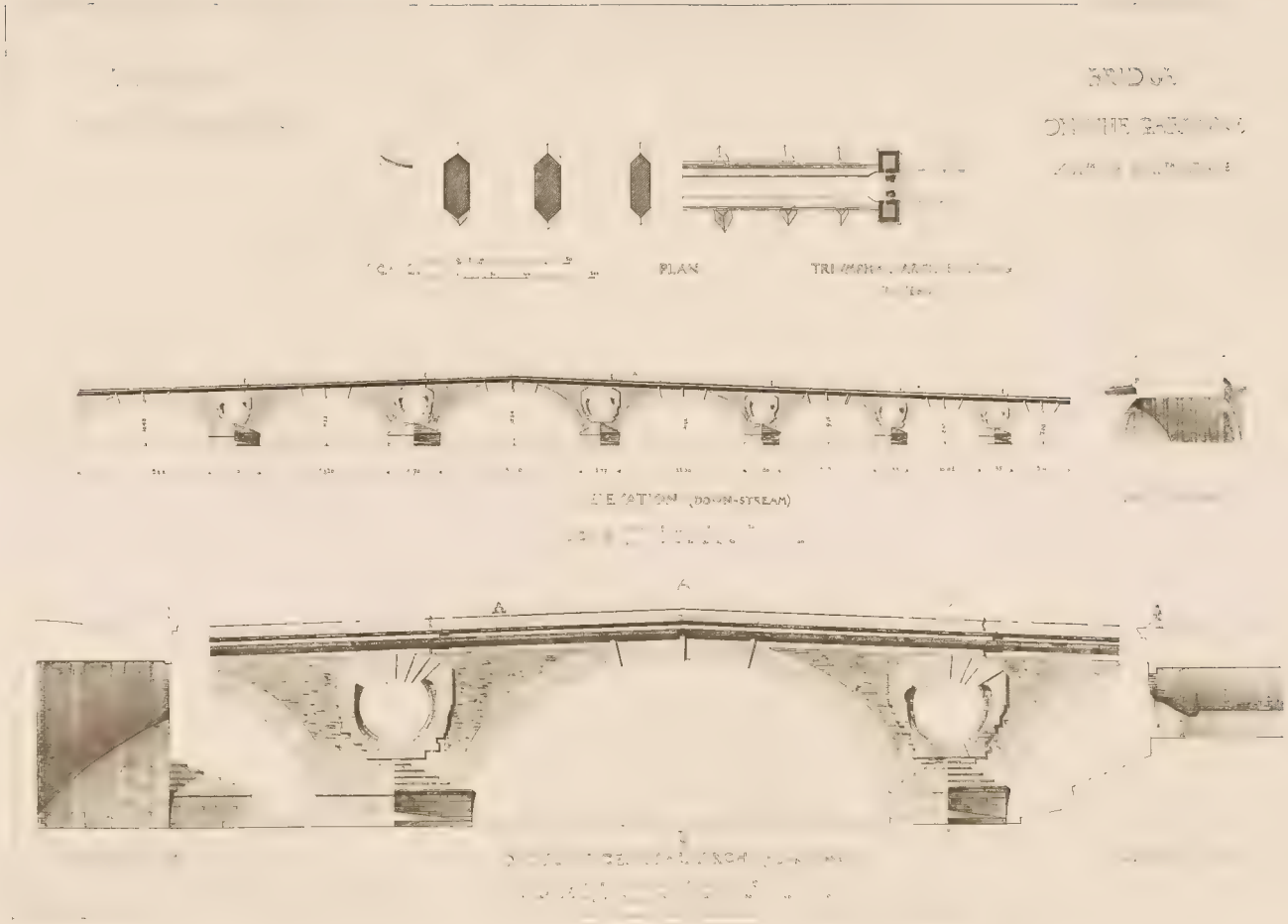
We may now turn to a study of those special features referred to above with the feeling, at least, of having made the acquaintance of the bridge. Its color is perhaps the first thing that strikes us, for both brick and stone mingle

pleasantly in its color composition, being used freely, in broad and well balanced proportions. Aside from the color, it is certainly unusual to find a marked difference in the level of the embankments at the two ends of the bridge. This feature alone creates a curious dissymmetry in the two slopes of the bridge, as well as variety in the span of the arches and width of the piers. As a matter of fact, there are seven arches, of which however the chief one, with an opening of 31.70 meters, is the third from the right end as we look down-stream. It forms the center of a group of five three-centered arches of considerable difference in size, the smallest having an opening of not more than 21.60 meters. Two semicircular arches of 16 and 13.50 meters in diameter, respectively, complete the bridge in the direction of the suburb of St. Cyprien. All of these arches are enlarged on the up-stream side by *cornes de vache*, or funnel shaped increases in the arch opening. The slope varies from 2.4 centimeters to the meter on one side, to 4 centimeters on the other.

So much for the arches; but the piers also are well worth our study. They vary in thickness from 11.70 to 7.33 meters, according to the span of the adjacent arches. From this fact alone we might conclude that the bridge was built in a thoroughly substantial manner. But perhaps a consideration of even more weight in arriving at such a conclusion is the question of the free-way, in a bridge exposed to the floods of so powerful a river as the Garonne. As a matter of fact the free-way was relatively restricted, but its effective area was increased by oval openings that add a note of interest to the tympana above the piers. As shown in an old engraving of 1783, it had been the intention to use a lion skin decoration about these openings, but the frames have been left in the rough[1].

In the base of the piers, which are themselves developed both up and down-stream into cut-waters, there is further matter of interest. These piers indeed are of an imposing mass, since the arches themselves have a depth of 20 meters, to which the cut-waters, both up and down-stream, add 10 and 8 meters respectively, thus giving the piers a total length of 38 meters. But the base of these piers is constructed in a manner not often met in modern bridges. The cut-waters rest, a little above water level, on lower cut-waters or foundation piers of even greater projection, a method which seems to have had good results so far as the preservation of the structure is concerned. It was a procedure frequently adopted by the Romans, as is shown in the piers of the bridge of St. Angelo, and in the central support of the bridge of Fabricius, to which reference has already been made in connection with the bridge of Sommières.

(1) A sketch of this motive which had a projection of from 30 to 50 centimeters is given in the work of Mr. de Dartein. The engraving referred to is by Berthault.


PLAN
(DOWN-STREAM)

The different levels of the embankments, in relation to the level of the road-bed, raised some difficulties with the approach to the bridge at either end. On the right hand, or town side, a widening of the roadway was arranged for, just as it meets the line of the abutment, in much the same manner as at the Pont Royal in Paris.

Thus, while this bridge is not unusual in architectural design, there are various features, as noted above, that are sufficiently unusual to warrant its inclusion in our chosen list.



THE BRIDGE AT MONTMORILLON, ON THE GARTEMPE
FROM THE DRAWING BY S. CHAMBERLAIN

THE BRIDGE AT CHATELLERAULT OVER THE VIENNE

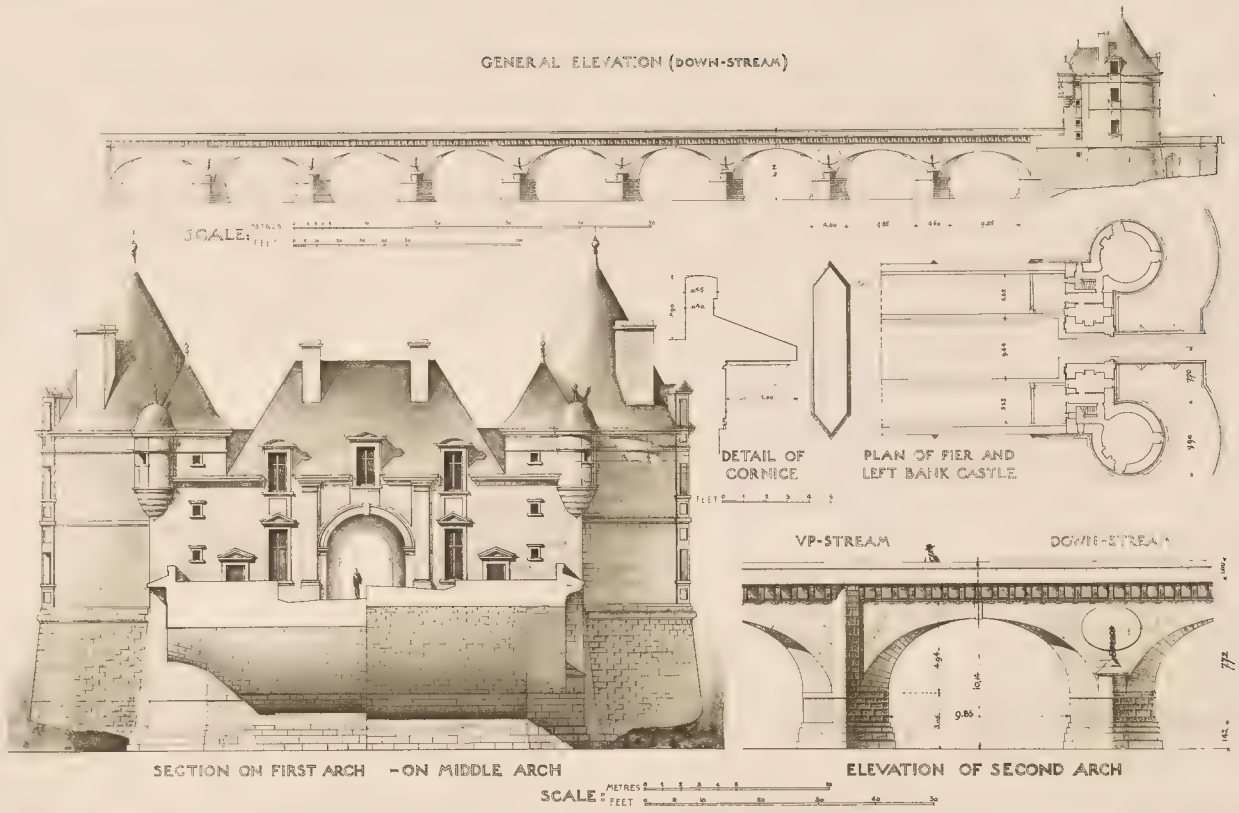
This substantial and handsome bridge, which spans the Vienne at Châtellerault, is much of a type with the Pont-Neuf at Paris. They resemble one another both in the number and outline of their arches, and in the general sturdiness of their appearance. Even though the former lacks the round towers of the Pont-Neuf, it makes a striking appearance both because of its general mass and because of the fine entrance-way which dominates one of the approaches.

Following the comparison with the Pont-Neuf at Paris, it is interesting to note that the two bridges were built at nearly the same time, for while that at Paris was completed in the years from 1578 to 1607, the one at Châtellerault, begun fourteen years earlier, was not completed until 1611. A still further bond between the two bridges lies in the fact that, after 1575, the work on the bridge at Châtellerault was directed by Charles Androuet du Cerceau, son of the celebrated architect, and own brother of the Jean-Baptiste Androuet who played so important a part in carrying on the work of the Pont-Neuf.

The bridge of which we are now speaking replaced a wooden bridge, that had in turn taken the place of a still older bridge, destroyed by a flood at the time when the city was besieged in 1370. In the same manner the wooden bridge was destroyed in 1556, after having been in a precarious condition since 1539. There was a delay of eight years following the first royal ordinance calling for the construction of a stone bridge, before a new decision was reached, this time by Charles IX, and before the entire problem was turned over to the builders Joguet and Gaschou-Belle. The work, however, advanced very slowly at first, even though an architect named Blondin was in charge

CHATELLERAULT

BRIDGE ON THE VIENNE
XVI TH - XVII TH CENT.



from 1575 to 1594. At this latter date, Charles Androuet was called to take charge of the work as royal engineer for the highways of Poitou. He remained in charge until his death in 1606, and there is no doubt that the greatest progress was made during the period of his responsibility. Because of the fact that the bridge was almost entirely built during the reign of Henry of Navarre it is frequently named either after him or his minister Sully.



The handsome entrance gateway already referred to, which so effectively completes the bridge, was threatened with absolute destruction in the second half of the eighteenth century. It was an engineer named Barbier who made this suggestion in 1768, together with that of eliminating the brackets from the cornice of the bridge, all under the guise of a restoration. The proposition, which was looked upon by the city magistrates as a piece of outrageous vandalism, had no immediate result; the idea, however, made some headway, and was taken up fifty years later, fathered by the Administration of the Ponts et Chaussées with characteristically aggressive persistence.

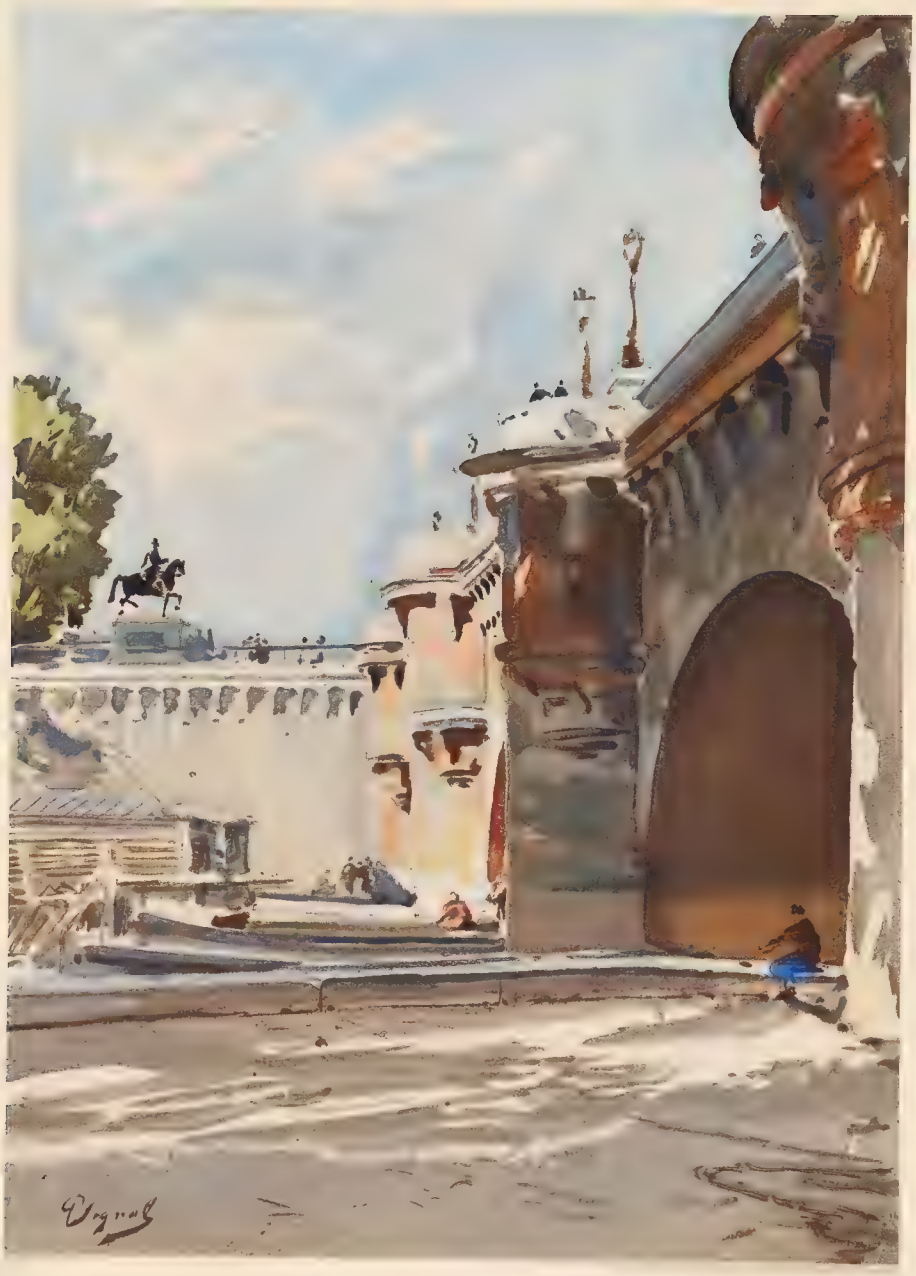
In spite of repeated protests from its municipal council, the city had to yield to the destruction of the central portion of the entrance. This was the more irritating because it was just this portion that belonged to the city, while the towers, for some unknown reason, belonged to the state. The city did, however, succeed in saving the towers, which it was allowed to buy back under a royal ordinance of 1823. Our drawing shows the entrance as it existed before the destruction of the central portion referred to above.

The bridge itself is of generous dimension, measures 135 meters in length between abutments, and has nine arches. These arches are unusual in one respect, that they are all of equal opening (about 9.85 meters) with piers of equal width (4.60 meters). Further, being three centered, it is perhaps noteworthy that the rise of the arches in mid-stream is only 15 centimeters less than half the diameter; in other words, the arches are almost semicircular, while in the case of those next the shore this difference amounts to more than 1.20 meters. Each one of these arches slopes off, on both the up and down-stream faces, into funnel-shaped *cornes de vache*, the angle being determined by the slant of the break-waters in plan.

Another unusual feature is that while the coping and cornice are absolutely level, the road bed has a fall from the center toward either entrance, a condition that is expressed, on the up and down-stream elevations of the bridge, by the varying distance between the crown of the arches and the level of the underside of the cornice.

There are break-waters both up and down-stream, but those on the up-stream side, having to meet the force of flood water, rise vertically to the height of the bridge cornice, where they interrupt the line of the consoles. The down-stream cut-waters are handled less abruptly, and rise only to a normal height above water level, being finished by stepped pyramids.

Considering the time at which the bridge at Châtellerault was built, its width is also notheworthy, — this is 21.80 meters over all, which, while it is less than the Pont Marie at Paris, is nevertheless greater than the bridge at Toulouse by 1.85 meters, and than the Pont-Neuf at Paris by 1.60 meters. In fact it seems almost too wide for its length.



THE PONT-NEUF AT PARIS

THE PONT NEUF, AT PARIS, OVER THE SEINE

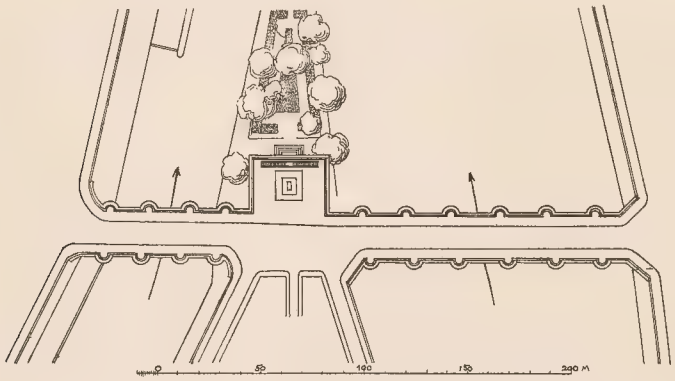
It seems quite absurd to our time and generation that a bridge built only a hundred years after Columbus discovered America should be called the "New Bridge"; yet to the French of Henry IV's time it was new, and to them also the solidity of its construction was as much a matter of pride as was its beauty. In fact, a man noted for particularly robust health was said to be "as strong as the Pont-Neuf", — somewhat of an exaggeration as we shall find, but nevertheless significant of current opinion.

Briefly, the Pont-Neuf was begun in 1578 and finished in 1607. It has three distinct elements: a long arm, measuring 150 meters, spanning the wide branch of the Seine; a broad platform or landing on the Isle de la Cité, 38 meters wide; and a short arm, measuring 82 meters, across that portion of the Seine flowing between the Isle de la Cité and the Latin Quarter or Rive Gauche. The width of the bridge is 20.80 meters.

Its location is only one of the reasons for its well deserved reputation, for it has qualities of rare beauty in itself. The proportion of solids to voids, the contrast of graceful curves with sturdy piers, the whole crowned by a cornice of unusual excellence in detail and scale and set off by the foliage of the little park that lies at the foot of its central platform, combine to give us a thing of such varied charm as rarely meets the eye. It is further well in character with the grace and charm that we all associate with the capital of France.

The bridge as we now see it represents in substance one of the two designs that were presented by a commission especially appointed for this purpose in 1578. The original design called for triumphal arches and a great

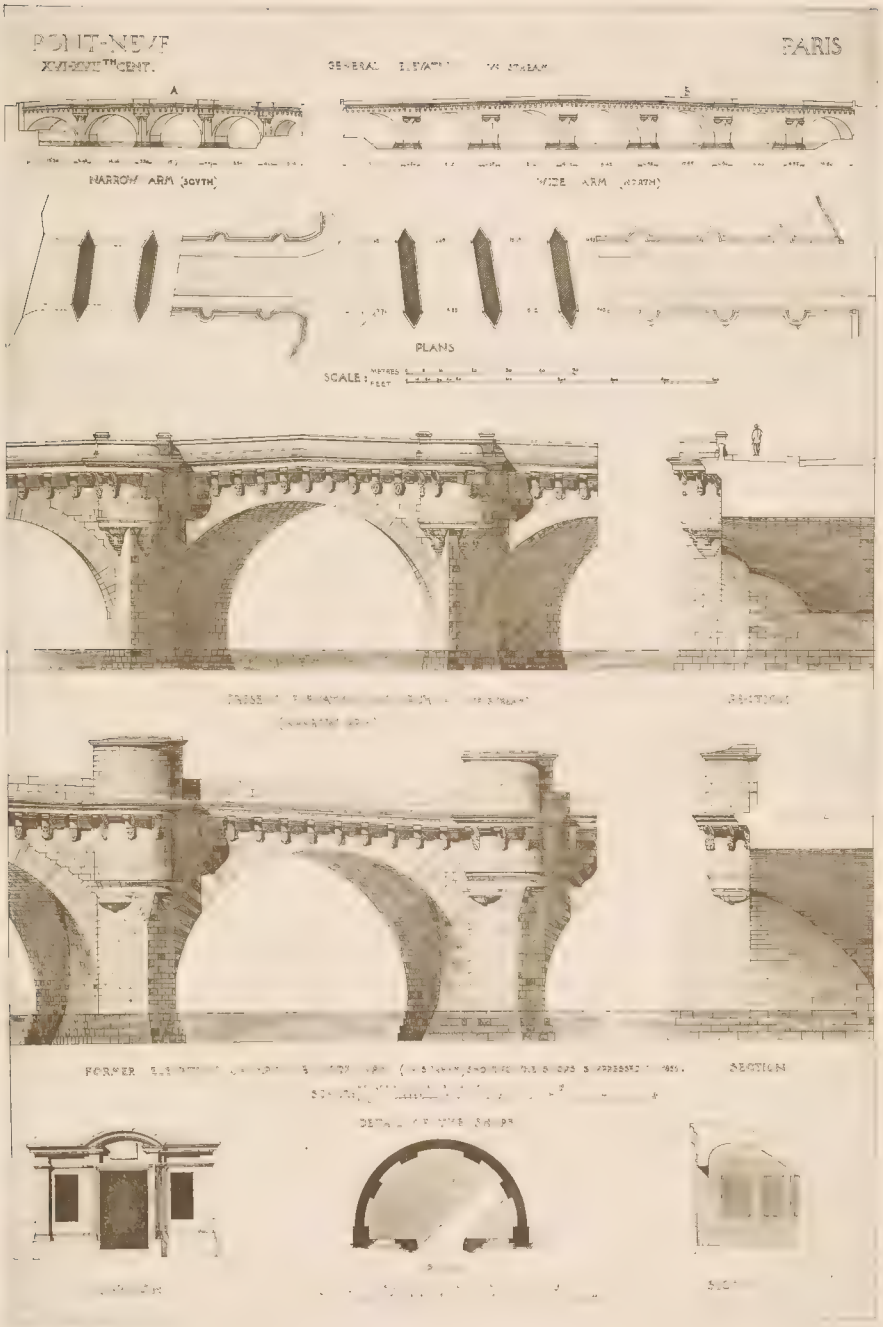
pavilion on the central landing, but these features never took material form. The selected design was remarkable in that in contained no provision for houses on the bridge — an indication of unusual foresight at a time when the road-way of any bridge was apt to be so invaded by this sort of obstruction as to be almost valueless from a traffic standpoint. Further evidence of the need for this additional bridge may be found in the limited capacity of the Pont-au-Change and the Pont Notre-Dame, and in the fact that both of these structures were in such poor repair that artillery was not allowed to cross them.



Haste was thus of the essence of this undertaking, and in 1578 on the 31st of May the first stone was laid by King Henry III in the presence of Catherine de Medici. Thanks to the very low water resulting from a serious drought[1], the piers of the shorter arm were raised rapidly to the spring of the arches. Then came the first interruption for, as the result of a demand for houses, the original plan had to be modified; and in order to adjust the newly made arches to the necessary increase in width, the "cornes de vache" were added that now differentiate the arches on this side from those on the longer branch, where, on account of the slower progress of the work, it was only necessary to lengthen the piers in order to meet the demand for increased width.

Though good will and energy were shown at the outset, neither was of long duration. Henry III made ineffective complaints as to the slowness of the work in 1583, and from 1588 to 1599 all work was stopped by the religious

(1) Journal of *L'Estoile.*


PONT-NEUF
XVI-XVIIITH CENT.
PARIS
GENERAL ELEVATION ON STREAM
NARROW ARM (SOUTH)
WIDE ARM (NORTH)
PLANS
SCALE: METRES FEET
SECTION
SECTION



wars. It was not until after this latter date, when Henry IV took upon himself personal responsibility for the completion of the work, that real progress was made. The energetic king, as an evidence of good faith, promised that he would cross a bridge at this spot within three years, and, being a man of his word, in spite of the fact that some of the earlier work had to be done over and strengthened, in June 1603, at the risk of his neck, he crossed on the newly finished arches, although the bridge was not completed for general use until three or four years later. So much pleased was the King with the final result that he forbade the construction of the proposed houses, and opened up a new street, the *rue Dauphine,* as a continuation of his new bridge.

Thus we see the bridge actually in use, and by such crowds that its existence was at once justified. Booths of every conceivable sort, for peddlers, jugglers, pastry cooks, etc., to the number of 178, took available space on both sides and on the center platform. In fact, they attracted such crowds and so interferred with circulation that they had to be suppressed in 1756, although

some were replaced in the round towers, which were built by Soufflot in 1775, only to be demolished in 1851.

In spite of the immense documentation that is available, there has long existed much diversity of opinion as to authorship of this bridge. The consensus of opinion among those best informed, including M. de Lasteyrie[1] and M. de Dartein[2], leads us to conclude that the construction of the bridge may be properly attributed to Baptiste Androuet and to Guillaume Marchand.

It may be well to note here, before proceeding to a more detailed analysis of the architectural features of the Pont Neuf, certain decorative elements that have always aroused comment. First among these is the statue of Henry IV which Louis XIII ordered from Franqueville in honor of his father. As it was not possible to have castings of such size made in France, the order went to Italy; that for the figure was placed with Jean Bologne and that for the horse with his pupil Tacca. Shipped in 1613 from Livourne, the two bronzes, which were lost in a shipwreck, were recovered with great difficulty and set in place in 1614, only to by thrown into the Seine in 1792, so that nothing now remains of this original work but a foot[3]. A clever temporary substitute was set up at the time of Louis XVIII's entry to Paris, in May, 1814; and four years later the present statue by Lemot was put in place on the day of the fête of St. Louis.

Certainly the little park of the *Vert-Galant*[4] is entitled to consideration in any appraisal of the decorative elements of the bridge. Lying smiling and green under the prow of the Isle de la Cité, it is not difficult to imagine it as one of the two or three little islands that occupied the space now covered by the platform of the bridge and the Place Dauphine. That every flood of the Seine covers and enriches its flower beds and lawns is perhaps one reason why it remains such a verdant spot of color at the foot of its somber masonry setting.

Let us turn now to a more particular analysis of the bridge, beginning with the smaller portion and its five arches. The axes of these arches are not parallel, so that the span of each arch varies according to whether it is measured on the up or down-stream face. But taking the average span of each arch, there is a variation in their diameters, for they are all but semicircular, of from 9.78 meters in the smallest to 15.56 in the largest. The thickness of the piers varies similarly, although neither of these facts is apparent to the casual observer.

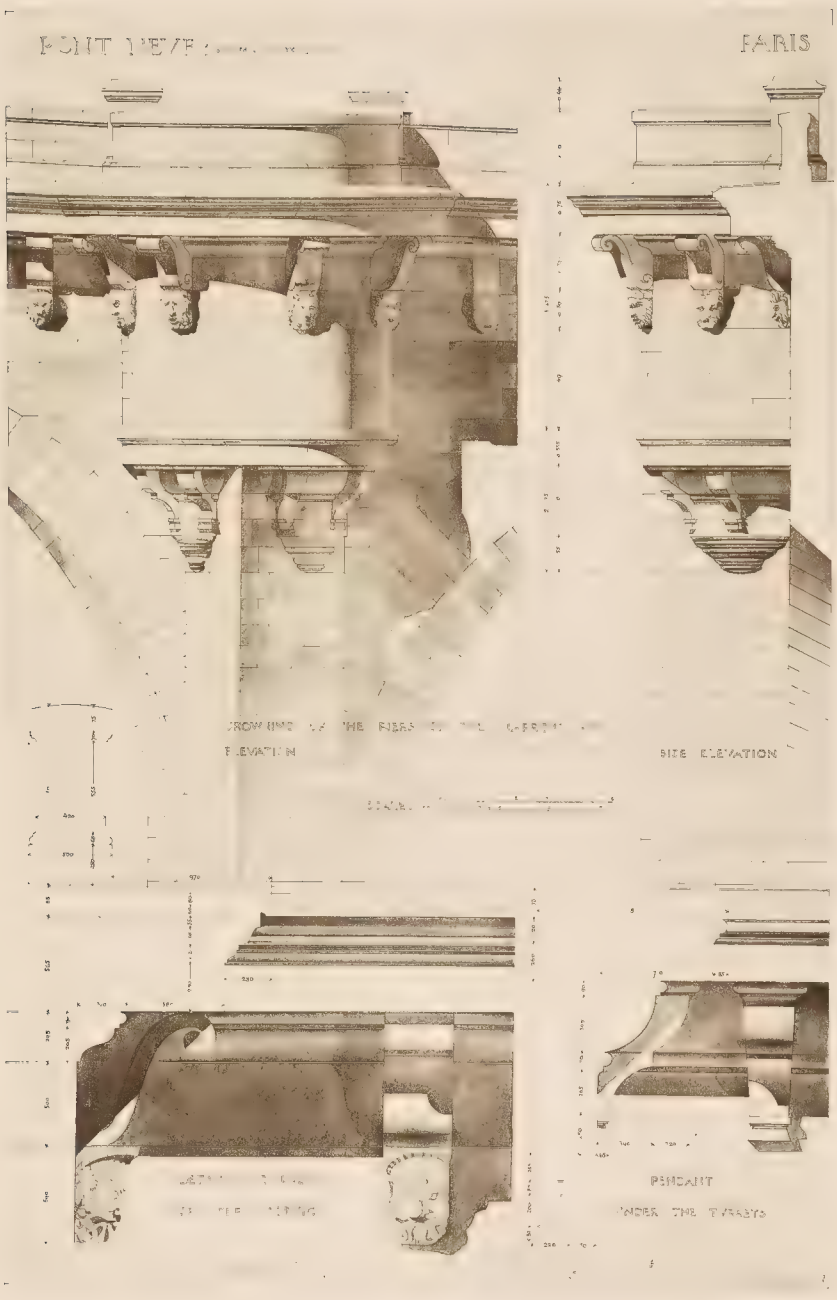
The cut-waters are triangular, being continuous in plan with the slope of

(1) Documents inédits sur la construction du Pont Neuf (1882).

(2) Etudes sur les ponts en pierre antérieurs au XIXe siècle remarquables par leur décoration.

(3) In the Louvre.

(4) A name by which Henry IV was popularly known.


PARIS
SIZE ELEVATION
PENDANT

the "cornes de vache". The round towers above the cut-waters are crowned, like the arches, by a vigorous cornice with handsome brackets. The masks that decorated the latter were at least in part credited to Germain Pilon. But these original masks no longer exist except in museums, those that we now see having been contributed by various modern artists; no less than 93, which are the work of Barye, are found on the down-stream side of the long portion. Aside from a slight lowering of the cornice in 1886 in connection with the elimination of some troublesome steps between the sidewalks and the road-way, this portion of the bridge has undergone very little change.

The long side, however, has been changed appreciably. It has seven arches with the same divergence of axes noted above. The smallest of these has an average span of 14.75 meters, while that of the largest is 19.47 meters. The thickness of the piers bears about the same relation to the openings of the arches as on the shorter side, their greater thickness causing the cut-waters to project well beyond the extreme face on the semicircular towers. The reader will recall that arches on this long side differ from those on the other in that they are without "cornes de vache". A still further change resulted from thorough repairs made in 1848 when, in an effort to reduce the grade of the road-way, the arches, with the exception of the one next the platform, were all made three-centered instead of semicircular.

Recalling the popular belief as to the solidity of the Pont Neuf's construction, it is perhaps only fair to note that this has not been entirely borne out by the passing of the years. So weary did the good bridge seem in 1778 of the constant and increasing demands upon its strength, that a commission, which included both Soufflot and Perronet, was appointed to make a thorough examination of its condition. Although the report indicated that the largest arch had been badly built, and that this was true of most of the arch stones on the long side as well, still no action was taken until 1827, when some slight corrections were carried out.

It was not until 1842 that a thorough overhauling of the long portion was undertaken under the direction of the engineer de Lagalisserie. It was in the process of this work that the arches were changed, as we have seen, from semicircular to three-centered, that adequate drainage was provided. and the entrances widened. In fact, the whole job was so well done that there has since been no anxiety as to its stability. The same is not the case with the small portion, which was in so precarious a condition in 1885 that the foundations of the piers, undermined by a deepening of the river bed, had to be entirely rebuilt. As a further precaution those foundations were surrounded by a protecting wall, which was in turn safe-guarded by a bed of broken stone.

And so we may bring our history to a close, hopeful that what we have

told may interest our readers in the qualities of a bridge whose charm must be apparent to the most casual observer. It is in many ways expressive of just those qualities of common sense and grace mingled with a vigorous bonhomie that characterised that most beloved of French kings : Henry of Navarre.





THE PONT-MARIE, PARIS

THE PONT MARIE AT PARIS

Although some years younger than the Pont-Neuf, the Pont Marie is nevertheless one of the oldest in Paris, and while it is less celebrated than its senior, it remains undeniably interesting. Its rather pronounced slope gives it a characteristic outline, and the simple motive of the niches crowning each of its piers is sufficient to add a note of real architectural value.

It has much of the charm of the Pont Royal, in the turn of its arches and the slope of its road-way, with somewhat more pretention to architectural interest in the decoration of the tympana above the break-waters, and in the fact that its road-way is at an appreciably greater height above the water level. Another peculiarity, that is unusual but not in the least related to its architecture, is the fact that the construction of the bridge was neither paid for, nor controlled, by the state, but was entirely a matter of private enterprise. The story is as follows :

Early in 1600, when the Isle de la Cité was packed so tight that its houses spilled over on to the bridges, the Isle St. Louis remained unoccupied except for a few huts, and was divided by a shallow, muddy stream into two sections. Three enterprising individuals — Le Regrattier, treasurer of the Swiss, Poulletier, secretary to the king, and a contractor, Christophe Marie, — recognising the possibilities of this situation, joined in asking permission to do the work

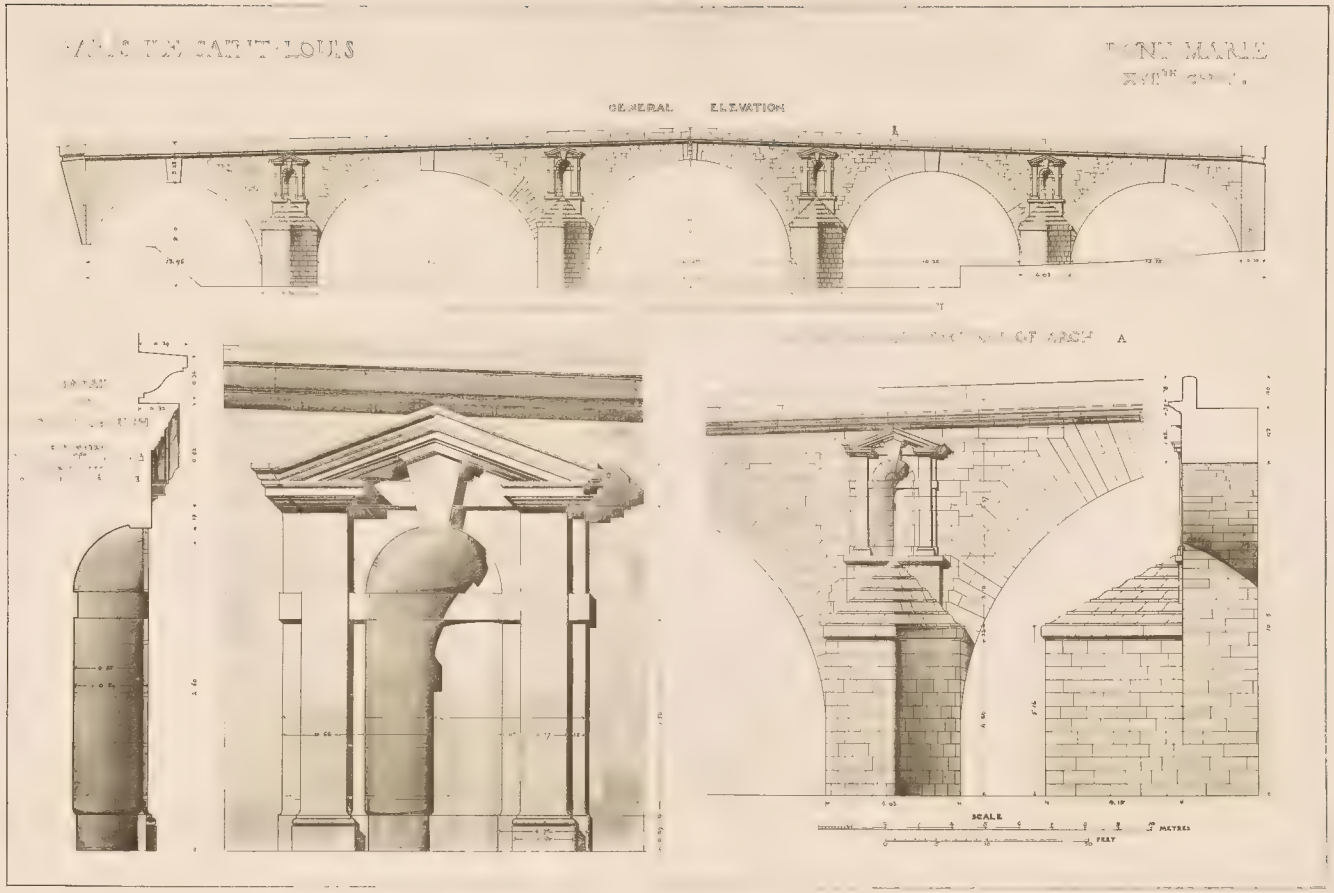
necessary to make this land available, on condition that the ground should become their property. Authorization was granted to them in 1614 by the king, on condition that they should build bridges to the island from both sides, and also fill in the muddy creek that cut the island in two, together with the establishment of some system of drainage.

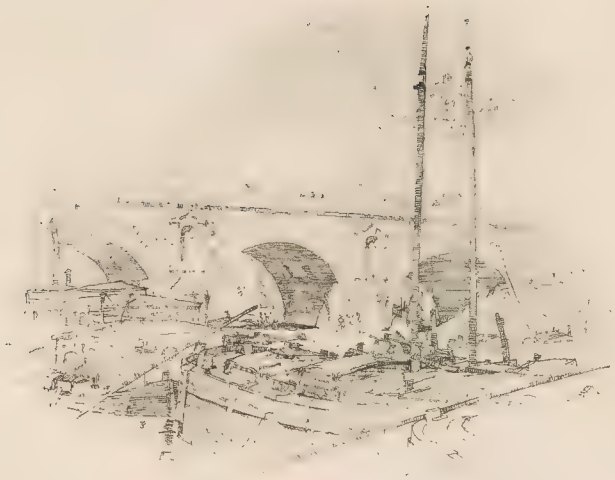
The number and size of the arches and piers as well as the freeway were all clearly detailed in this authorization, which also included permission to build



houses on the bridge similar to those on the Pont Notre-Dame, merely reserving 24 feet of the width for circulation. It appears that these houses had a shop and kitchen on the ground floor, above which were three stories and an entresol, each containing one room and an alcove. The bridge was 92.25 meters in length, and its width 23.60 meters.

Named, as we may easily surmise, after the contractor mentioned above, the first stone in its construction was laid in 1614 by Louis XIII and Marie de Medici. Although the inscription now on the bridge says that it dates from 1614-15, it appears that the work was not entirely finished until 20 years later. Flood and disaster followed close on the heels of its completion, for in the mighty floods of 1658, when the ice broke up in the Seine on the last day of February, two of the arches were swept away, and with them 20 houses with their occupants


GENERAL ELEVATION
SCALE
METRES
FEET



amounting to 120 souls (1). Between this catastrophe and 1670, when these arches were entirely rebuilt, the occupants of the remaining houses were twice warned to leave. But though the arches were replaced the destroyed houses were never rebuilt. In fact in 1741, when another flood threatened, 18 others were pulled down, and the remainder were demolished by law in 1788.

Since then, except for some slight modifications in the slope of the roadway, no events of particular interest have happened to the bridge. It remains a structure of fine qualities; the handling of its proportions and the treatment of the niches are both noteworthy. The bridge seems to share in or even add to that peculiar charm which so distinguishes the Isle St. Louis for all who know it. It has qualities of spacious width and reposeful dignity that belong with this pleasant back-water in the hurrying stream of Parisian life.

(1) A similar mishap had occurred in 1499 to the Pont Notre-Dame when, fortunately, only four or five persons perished. But active steps were then taken to find who was responsible; — the Prevôt of the Merchants, the Echevins of that and the preceding year, the Procureur of the king, the Greffier, and the two Receveurs of the City, were all sent to prison where, in addition, they paid heavy fines, and some even died.



THE PONT-MARIE, PARIS

THE PONT ROYAL AT PARIS

This bridge, even if it lacked other merits, should endear itself to architects because of the great names associated with it. Drawn by Mansart, it was built by Gabriel's grandfather, and the work officially accepted by Liberal Bruant. It has, however, definite claims upon our interest aside from the association with these famous men. The breadth and simplicity of its composition combine with the beauty of its stonework to give a result that has been admired from many points of view, perhaps particularly from the quais and the shores. It offers a further element of interest in that, from a certain standpoint, it may be regarded as the first of the modern bridges; for it is indeed the first where care was taken not to choke the river with piers, where the road-way was given a sufficient width to accommodate a considerable traffic, and where a new method was employed in building the foundations, that for two centuries thereafter was almost uniformly followed.

Apparently, neither the architect who conceived the designs, nor the contractor who carried out their construction, is entitled to credit for the practically perfect performance of the work on this bridge; for such serious difficulties were encountered at the very outset, in building the foundations of the first pier, that it was decided to call upon the services of a preaching brother named François Romain, from Holland, who had made a reputation in connection with the building of the bridge at Maestricht. Gauthey, in his *Traité des Ponts,* gives most detailed information about the building of the Pont Royal, including data concerning the foundations, which were apparently started 15 feet below mean water level. This information prompts Mr. de Dartein to point out that brother François Romain might justly claim

credit for initiating three new processes in the construction of the Pont Royal alone, — the employment of a dredge to prepare a bed for the foundation, the introduction of pouzzolane in the mortar of the masonry surrounding the piles and, finally, of utilizing the principle of caissons, which has since been employed universally for this type of work.

The Pont Royal replaced a wooden bridge which had been carried away in 1684, and which, in its turn, had been built to replace a previous wooden bridge dating from 1632 and burned in 1656. The existing bridge was built during the years from 1685 to 1687, at the expense of the king. Thanks to Gauthey we know its exact cost, 675.000 francs, according to the figures of Jacques Gabriel, architect to the king, and contractor for his buildings [1], who had taken part under the direction of Mansart, during the preceding years, in the important work at Versailles. The estimate is dated January 5, 1685, and the first stone was set in place on the 25th of the following October. From Gauthey we also learn that Gabriel died nine months after the work started, but that his widow, in accordance with the usage of the period, and contrary to her own preference, was constrained to accept the completion of the work on the bridge, as part of her inheritance. The work was directed by her brother, Pierre de l'Ile, himself architect to the king, but the responsibility for the execution of the contract rested upon her. None of these somewhat unusual conditions seems to have delayed the progress of the work, which as a matter of fact was more rapid than in the case of most bridges hitherto built.

We have noted that an effort was made in the Pont Royal to assure a more adequate free-way than in previous bridges, so that the use of the elliptical, or better the three-centered arch, may be regarded as an innovation in Paris, where, up to this time, the arches used had been nearly semicircular. It is only fair to remind our readers, however, that about one hundred and twenty years earlier, the great Ammanati had achieved, in his bridge of the *Trinita* at Florence, an idea that was even more daring and modern. This bridge [2] spans the Arno with three arches 29 meters wide, separated by piers 7.90 meters in width. The curve of these arches is very much flattened : for half of the small axis of the ellipse [3] measures only 4.57 meters, its center being 3 meters above mean water level.

The lines of the arches in the Pont Royal were certainly much less flattened than those in the *Trinita*, as is shown by the fact that the relation

(1) This is Jacques Gabriel (1632-1686), a nephew of François Mansart the elder, father of Jacques-Jules Gabriel, the first engineer of the *Ponts et Chaussées* (1667-1742), and grandfather of Jacques-Ange Gabriel, the famous architect (1698-1782).

(2) See diagram p. 16.

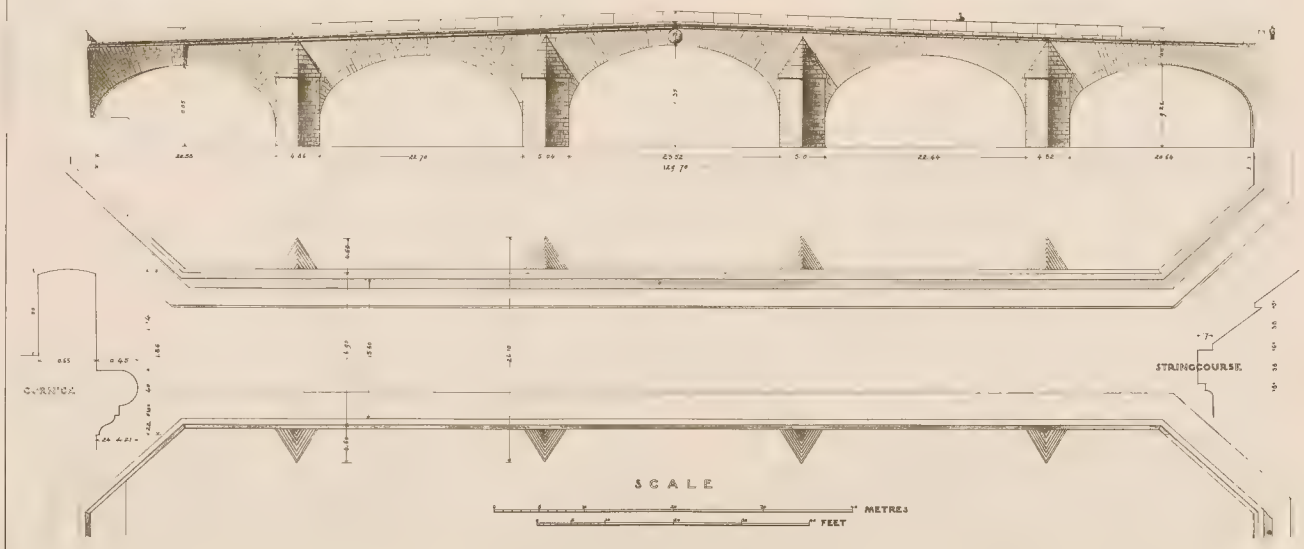
(3) To be exact, the elliptical arches are slightly broken at the crown.

PONT ROYAL ON THE SEINE

PARIS

XVII TH CENT.

GENERAL ELEVATION AND PLAN





THE PONT-ROYAL AT PARIS

between the small and large axes of their curve is as 1 to 1-1/2. Gauthey gives us the exact dimensions of arches and piers as originally planned. The central arch was to have been 23.40 meters wide, its two neighbors each 22.42 meters, while the arches next the shores were to be only 20.80, with piers in each case 4.50 meters thick. As occurred in many Renaissance buildings, even when as in this case the work was most carefully executed, the actual construction was not carried out in strict conformity with the predetermined dimensions. M. de Dartein has noticed a variation of as much as 27 centimeters in the width of the arches, while the width of the piers nearest the shore was as much as 4.86 and 4.82 respectively, and that of those in the center 5.04 and 5.10. The roadway has a total width of 16.81 meters inclusive of the parapets, and of two sidewalks each measuring 2.15 meters.

There was an absolute solidarity between the arches and the rest of the masonry, a condition which might have resulted disastrously in a structure less perfectly built, but up to the present time no lack of cohesion has appeared. As a matter of fact the arch stones and the stones in the face of the bridge are bound together by anchors.

The bridge, while of the utmost simplicity in form, and without a vestige of decoration, nevertheless holds the attention of everyone whose eyes are open to the beauty of proportion. The unassuming dignity of its graceful arches, the pleasing rise and fall of its sloping lines, seen against the foliage that lines the banks or the distant view of the Ile de la Cité, give a picture of exceptional beauty.

BRIDGE AT BLOIS (Loir-et-Cher) ACROSS THE LOIRE

Blois boasted in the early days of the eighteenth century a fine old bridge of particularly picturesque appearance, that spanned the Loire on twenty semi-circular arches. In addition to fortified towers at either end, like the bridge at Cahors, two mills, a chapel and several houses accentuated the charm of the old structure. But on the 5th of February, 1716, there arose a terrible flood which, finding no adequate outlet for its energies, forthwith overthrew thirteen of the twenty arches, and thus gave excuse for the erection of the bridge that exists today.

This catastrophe happened most opportunely, for only four days previously, in this first year of Louis XV's reign, an organization for the maintenance of the bridges and highways[1] of the country had been created, and the distinguished Jacques Gabriel [2] was named head engineer. Under other circumstances there would have been endless delays, but Gabriel threw himself eagerly into his work. His drawings were completed and approved by the end of the following August, and the contract for the work signed on November 14th, for the sum of 900.000 francs. It took eight years to complete the bridge, Gabriel being aided by two engineers, de Reguemorte and Pitrou, so that on March 4th, 1724, it was opened to traffic.

Although splendidly built, it had two narrow escapes from serious damage; first, in November, 1793, when they started to destroy one arch in order to cut off the retreat of the Vendéan troops and so seriously damaged the arch that it had to be thoroughly overhauled some years later. The second attempt came in the war of 1870, when the arch next to the center was blown up; but so perfect was the construction that the adjacent arch did not suffer. An

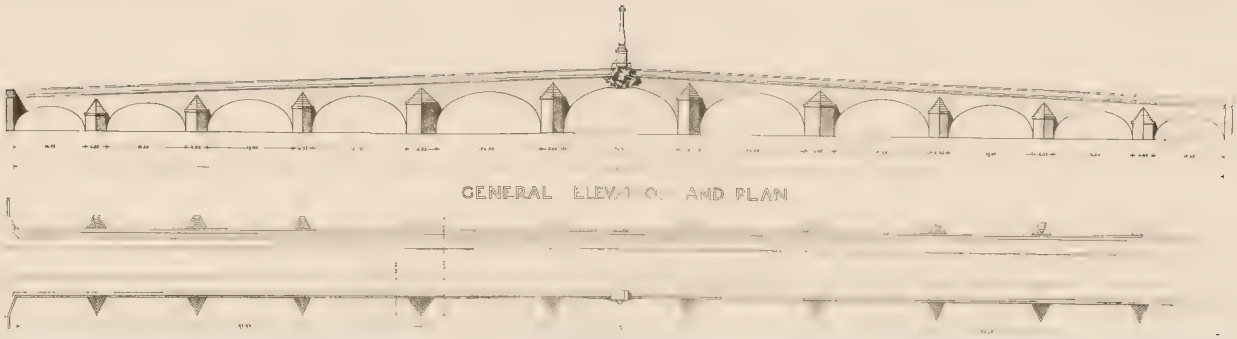
(1) Corps des Ponts et Chaussées.

(2) Jacques Gabriel, 1667-1742, was a great nephew of the famous Mansart, a distinguished architect himself, and father of that even greater Gabriel of the end of Louis XV's reign.

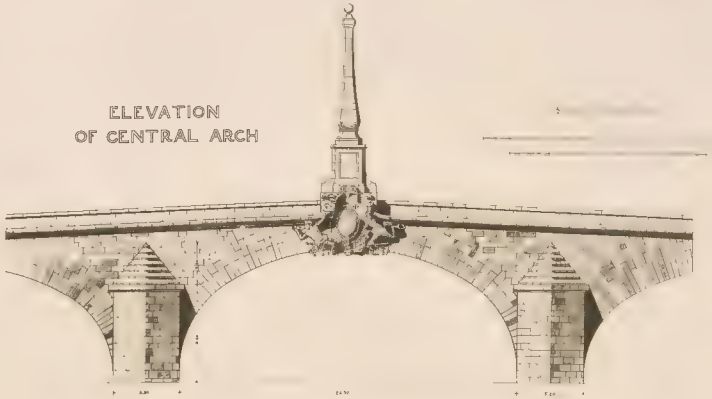
BLOIS

BRIDGE ON THE LOIRE

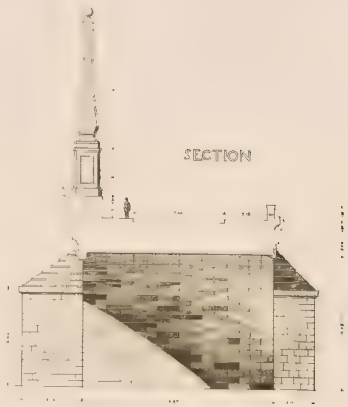
XVIIITH CENT.



GENERAL ELEVATION AND PLAN



ELEVATION
OF CENTRAL ARCH



SECTION

attempt by the Germans to overthrow the piers a little later was also unsuccessful.

Gabriel's bridge, the first monument of Louis XV's reign, has come down to our time in practically perfect condition(1). Its lines and elements of composition are so simple that we scarcely realize the skill that has created this thing of grace and perfect proportion, where monotony and dull repetition were an almost inevitable alternative. To begin with, it is 280 meters long, and has eleven arches, but neither the one nor the other seems excessive, so skilfully have the slanting lines of its rise counteracted this great length, and so unconsciously have the charm and variety of the individual arches distracted our eyes from their number. Each arch is a study in proportion in itself; as its rise is lessened by the downward slope of the roadway, so its span is correspondingly reduced. And yet the designer did not lose sight of the practical needs of his structure. Knowing the ever-present risk of dangerous



floods, he placed between the fourth and fifth arch, and also between the seventh and eighth, a particularly sturdy abutment-pier, so that if any one of these sections so formed should be carried away, the balance would have a better chance of resisting.

On the parapet crowning the center arch, up-stream, is practically the only decorative feature of the bridge. Here is a graceful obelisk, skilfully studied in composition, with a cartouche of the royal arms and two flanking figures of tritons. This is the work of the sculptor Coustou, better known for his "*Chevaux de Marly*" at the entrance to the Champs-Elysées, in Paris.

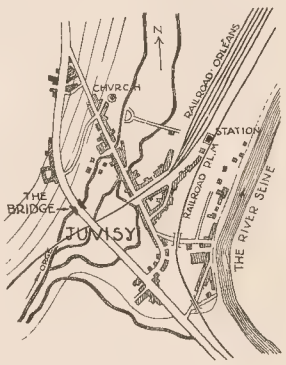
Both architect and sculptor may be justly complimented on the success of their joint efforts, — a success that is indeed repeated in the interesting bridge at Juvisy.

(1) Only the crown and the fleurs-de-lis of the coat of arms were mutilated in the Revolution.

BRIDGE AT JUVISY ON THE ORGE

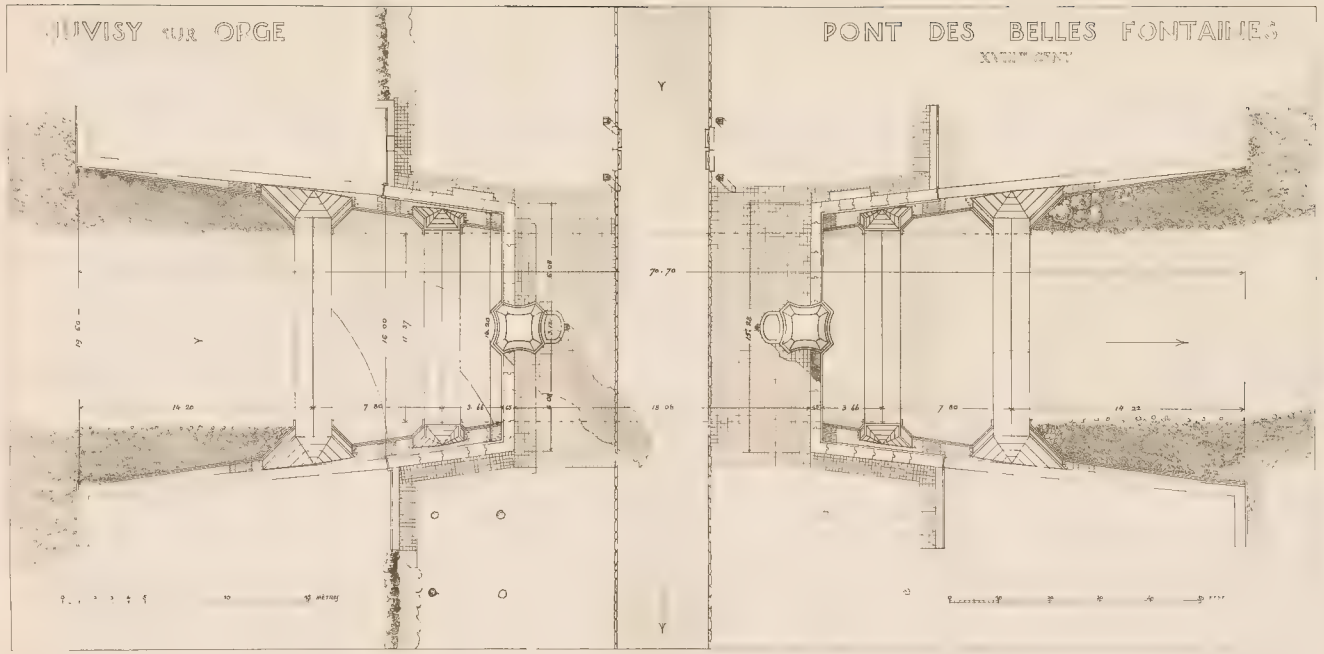
(KNOWN AS THE "PONT DES BELLES-FONTAINES")

This bridge is reached by the main road from Paris to Antibes. Fifteen kilometers from Paris, and before reaching its first important town at Fontainebleau, it tops the heights above the village of Juvisy, from which point the road drops some 40 meters to the valley of the Seine. Towards the end of the descent, and where the road is still about 15 meters above the valley, it crosses by means of this bridge a little stream called the Orge, which comes from the direction of Arpajon and Dourdan.



The unusual situation of this bridge, cutting across the embankment carrying the steeply graded (4 to 100) road, has resulted in a solution of far greater interest than its modest dimensions would seem to justify. The Orge indeed is hardly 11 meters wide, and the bridge crosses it in a single arch of 11.37 meters span, the crown of the arch being 13 meters above the river.

During the construction of the bridge, which was started in 1727, two incidents occurred that enhanced, even though only incidentally, the interest of the design. First of these was the realization that the pressure from the fill against the two retaining walls was much greater than had been anticipated in computing the thickness of these walls. Rather than lose the advantage of what had already been accomplished, it was decided to overcome this difficulty by building seven buttress-arches which should counterbalance the excess of pressure brought against the retaining walls, and which were of the same span as the


JUVISY sur ORGE
PONT DES BELLES FONTAINES



THE PONT DES BELLES FONTAINES, JUVISY

main arch, though placed at half the distance above the river. Three of these arches are located beneath the bridge proper, the remaining four being distributed symmetrically on either side. It requires little imagination to appreciate the added interest that these seven arches, with their constant play of light and shade, have brought to the original structure, with its single span hung high above the stream on its sheer retaining walls.

The second incident that added unintentionally to the interest of the bridge



was the discovery of a spring of most excellent water(1), and with so generous a flow that it threatened serious inconvenience to the work. The happy decision was reached of utilizing this unexpected and somewhat disturbing element as an ornamental feature. In consequence we have the two handsome fountains after which the bridge is named. They are placed on either side of the roadway, and complete in a most charming manner the composition of the bridge. They are designed in the form of square pedestals with chamfered corners, five meters in height, surmounted by decorative groups accredited to

(1) People still come from an appreciable distance to draw their water from this spring.

Coustou. The groups, which have been somewhat damaged, represent on the down-stream side Father Time holding an image of Louis XV, and up-stream a globe, decorated with the lilies of France and supported by two cupids. The water flows from a decorative mask in the face of each pedestal into stone basins.

On one pedestal, there is a Latin inscription to the following effect: " In the year 1728 the most Christian King Louis XV took pains to reduce the steep slope of this road, which had always been difficult and almost impracticable, making it both more usable and more pleasant by trimming and dislodging the rocks, lowering the hill, and building this bridge." On the other pedestal is a simple statement that the bridge was restored in 1813 by Napoleon.

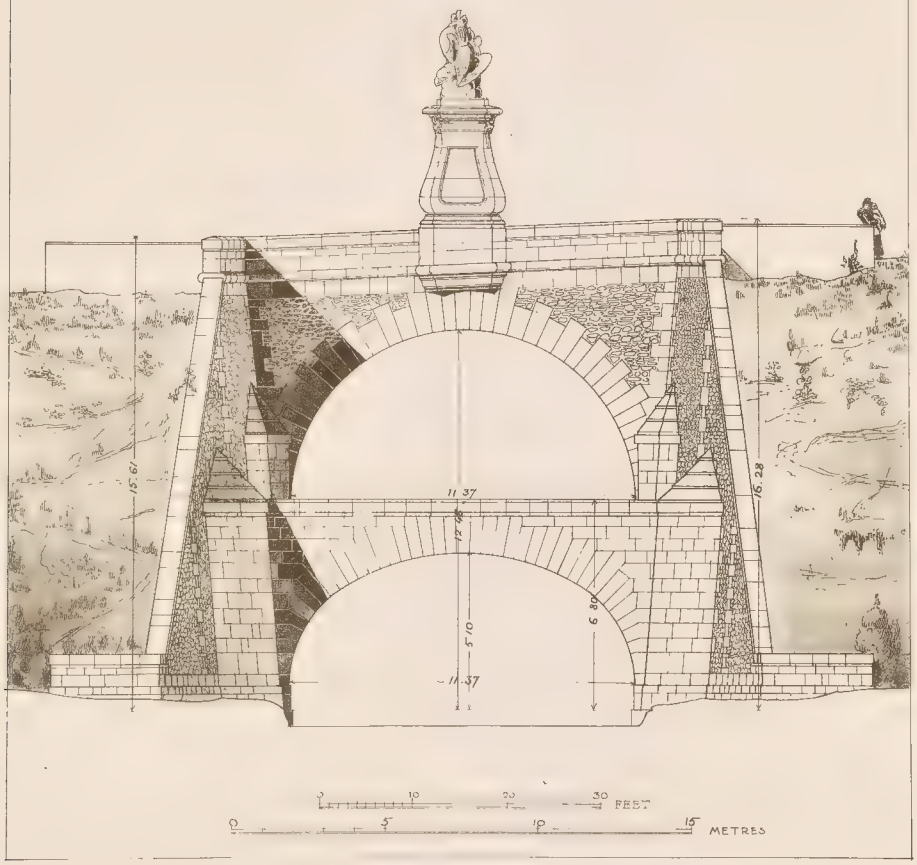
The author of this handsome bridge is unknown. Mr. de Dartein is of the opinion that there are good reasons for attributing it to Jacques Gabriel. He points out the similarity between it and the central portion of the bridge at Blois : " Composed with the utmost simplicity, both are decorated by a central motive of a pyramidal form, the carving of which is undoubtedly by the same hand, and both of which bear a striking similarity in outline and in mouldings "[1].

The structural features of the bridge call for no particular comment. The drawings show readily those portions of the work that are in dressed stone as compared with those that are in rubble. But no drawing can quite give the quality of intimacy which is the peculiar charm of this bridge, and to which the setting particularly lends itself. It will well repay a visit for any who are ready to take this short trip from Paris.

(1) *Etudes sur les ponts en pierre, etc.* Vol. II.



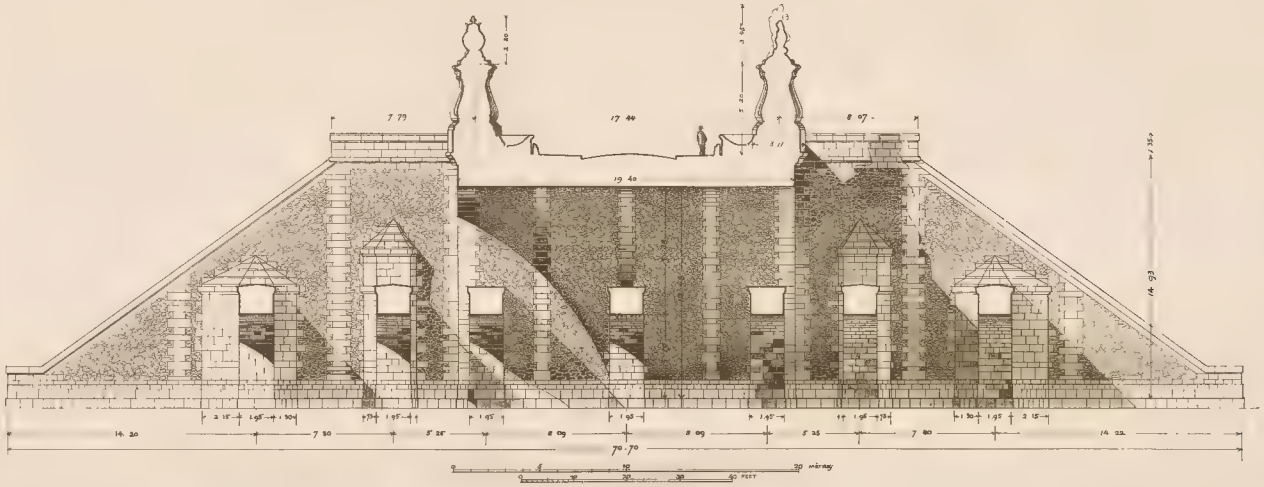
PONT DES BELLES FONTAINES
AT JUVISY.



JUVISY SUR ORGE

PONT DES BELLES FONTAINES

XVIII TH CENT.



THE BRIDGE OF ORNAISONS (AUDE) ON THE ORBIEU

This is an imposing piece of work, for though the bridge proper only measures 71 meters in length with a width of 8.80 meters, its over-all dimension, if we include the ramps that lead up to it, is not less than 340 meters. It is at only a slight distance from the village of Ornaisons, a township in the department of the Aube, just where the road from Narbonne to Toulouse crosses a stream called the Orbieu [1].

In general appearance it bears a strong resemblance to the Mediaeval bridges, particularly in that it has a large central arch flanked by two lesser ones to span the bed of the river, and two other and still smaller arches near the sloping approaches. This arrangement necessitates sharply sloping sides, which actually have a grade of 6 1/2 to 100. As is so often true, the appearance of the bridge is improved to about the same extent that the traveller is inconvenienced by this excessive slope.

There had never been anything but a ferry at this spot up to the first third of the XVIIIth century, and this was in no way adequate for a rich country having constant relations with Toulouse and Narbonne. As the result of a decision reached in 1742, a commission was appointed to report upon a location for a bridge across the Orbieu, and its report was made the following year. The preparing of designs and estimates was entrusted to de Carney, director of public works in the district and a fairly skilful engineer. In this instance, he seems to have shown himself either less skilful or less prudent than usual, for the execution of the work on the bridge of Ornaisons gave him many an anxious moment. To begin with, the location proved much

(1) The Orbieu is an affluent of the Aude. The bridge of Ornaisons is about six kilometers to the southeast of Lézignan.

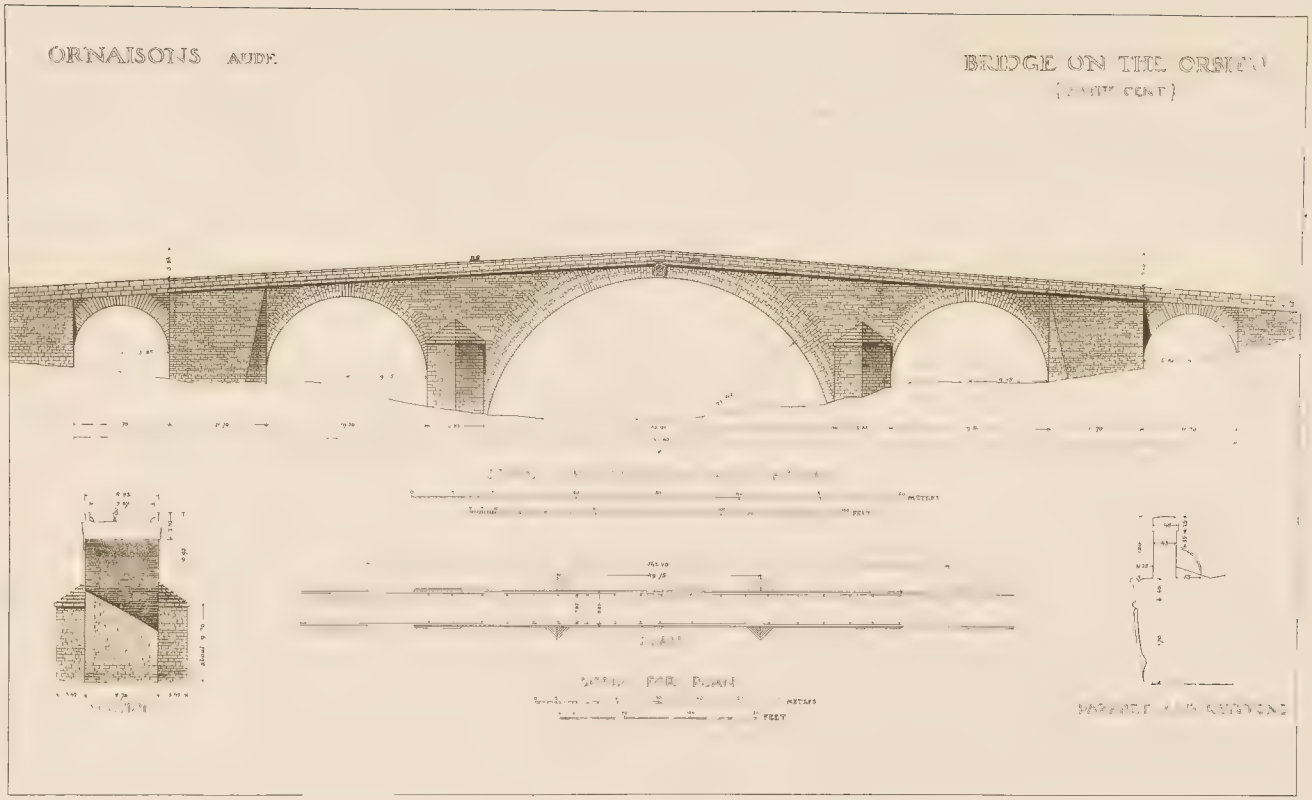
less desirable than had been at first supposed. The selection of this site was made deliberately because the river was narrower at this point, and also because the rocky bed appeared to offer an excellent foundation for the piers. But the contract having been awarded in 1745 to an individual named Projet, and the work actually started, it was immediately recognized that the rocky bed did not offer an adequate foundation, and the idea of a foot-hold in the middle of the river-bed had to be given up. The designs were consequently redrawn and, as a result, we have the noble arch of such engaging lines that now spans the Orbieu with an opening of 43 meters.

With the letting of a new contract, which was awarded a year later, came an increase in the cost of about 65.000 francs. But the troubles did not end here, for three years later, just as the first stones of the great arch were being placed on the centering, the latter gave way. The work was appreciably delayed in consequence, and the engineer's judgment brought seriously into question. Following this mishap, the idea of building up the centering without a central support was abandoned, and it was decided that, for an arch of such a span, equal in fact to that of St. Peter's at Rome, it would be wise to follow the procedure outlined by Michael Angelo; namely to support the centering by a pier which could be removed when the centering had served its purpose [1]. De Carney died with the completion of the work in 1752, so that the formal acceptance was made the following year by Garépuy.

The construction of the cut-waters is noteworthy in that their masonry is entirely independent of the piers, being merely placed in juxtaposition one to another without any bond. It seems worth while calling attention to the pronounced batter of the face of the abutments and their splay at 45° in plan next to the secondary arches with their span of 19.50 meters each.

In spite of the period in which it was built, the outline of this bridge, as was remarked earlier, is so strongly Mediaeval in character as to be comparable with the bridges at Espalion or at St. Affrique, or even with the less well known bridge of La Voûte-Chilhac on the Allier.

(1) See Belidor : *Architecture hydraulique.*


ORNAISONS AUDE
BRIDGE ON THE ORBIEU

BRIDGE OF ST-LAURENT AT CHALON-SUR-SAONE

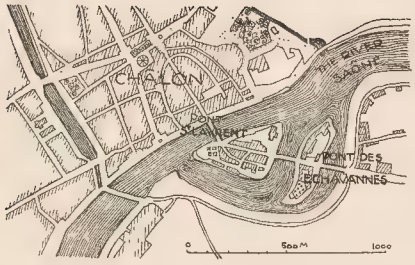
The monumental character of this bridge is certainly more frankly expressed than in almost any of the older French bridges. Its importance and quality are all the more striking because of the modest nature of its surroundings in the town of Châlon.

Although the spirit in which it is treated is so truly classic as to be all but Roman in its breadth, yet the elements of which it is composed are essentially simple, — semicircular arches, a bracketted cornice and, dominating a parapet without a vestige of ornament, eight obelisks seven meters in height. These obelisks have been used in a singular manner, for instead of being placed with their faces parallel to the axes of the bridge, it is their diagonals that are thus parallel. Furthermore, their location, beyond or outside of the parapets, leaves their edges free to run uninterruptedly from summit to water level, so that they form at their bases the cut-waters of the piers.

Although, as we have said, supplying a quite unexpected character to its modest surroundings, the bridge of St. Laurent is not lacking in dignity. The elements of which it is composed were in almost universal use during the XVIIIth century, and yet they have been so skilfully employed as to recall the best of the Roman work. Its simple arches suggest the bridge of St. Angelo; indeed, its lines would not look out of place in a model of Rome at the time of the Caesars.

Emilian-Marie Gauthey, who is responsible for this interesting bridge, was a native of the town in which it was built. He was born at Châlon in 1732, was one of the first pupils of the *École des Ponts et Chaussées* founded under the direction of Perronet in 1747, and, at the age of twenty-six, returned from school to become assistant engineer to the Burgundian district. From then on, until as inspector-general he achieved the crowning position of his career, he continued to design and erect a series of most interesting structures throughout this entire region. The fact that he had studied architecture at Paris, as a student of Dumont(1), enabled him to give so truly architectural an appearance to his compositions that they have seldom been surpassed in this respect. His first accomplishment, in 1766, was that modest little bridge over the Thalie, just outside of Châlon, which we will show in Plate XXXIII, and of which he made so signal a success. He began the Pont St. Laurent in 1776 and six years

(1) This refers to Gabriel-Pierre Dumont, born in 1720, died in 1791, who won the Grand Prix de Rome in 1737, and was the first to enjoy the privileges of the French Academy in Rome.



later, in 1782, as continuation of it, he built the bridge of the Chavannes[1], connecting the faubourg of that name with the second island in the Saône. During the same year he built the bridge of Cuisery on the Seille; and it is to him also that we owe the bridges of Navilly on the Doubs, of Gueugnon and many others, as well as the laying out of several important canals, and the publication of highly valued treatises, such as his *Traité des Ponts*, published in 1809, three years after his death.

The three first of the bridges by Gauthey which we have reproduced in this collection are all to be found on the same road, *Route Nationale n° 78*, which comes from Nevers and passes beyond Châlon towards Louhans. If we were to suggest a criticism that is common to all of his designs, it vould be the reproach that all tend to be rather more monumental than their surroundings require. There is no doubt that the Pont St. Laurent is striking not only because of the originality of the treatment, but also because of the breadth of its decorative composition, all the more marked for the banality of its immediate surroundings. But this is really being hypercritical, for we certainly would put ourselves in the wrong if we insisted on perfection when what Gauthey has actually accomplished is of such unquestioned excellence. It would indeed be exacting to require that work of such vigorous qualities should not have the slightest defect.

We might more justly reproach the designer of the Pont St. Laurent with a lack of grace in his handling of the mouldings. As we approach the bridge from the town and pass between these two rows of obelisks, — almost as if we were coming to an Egyptian temple, we are struck by the total absence of any moulded profiles. While we may agree that his idea for the handling of the obelisks precluded the use of a decorative base, still the parapet is the merest wall, without even a crowning member, and we have actually to place ourselves so that we can see the cornice of the front elevation before we can find the slightest play of light and shade. Even the cornice itself has been reduced to such elemental simplicity that it looks almost impoverished. A study of the detail shows a constant superposition of one square member upon another, without the usual interposition of curved members which is the underlying secret to the charm of classic mouldings.

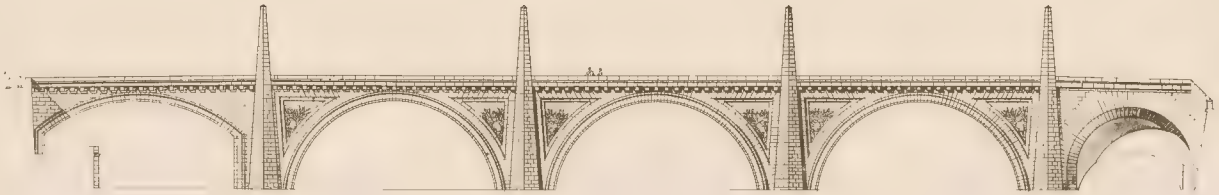
It is noteworthy that the bridge which we are discussing was not entirely

(1) Just as often called : Pont *des Echavannes*.

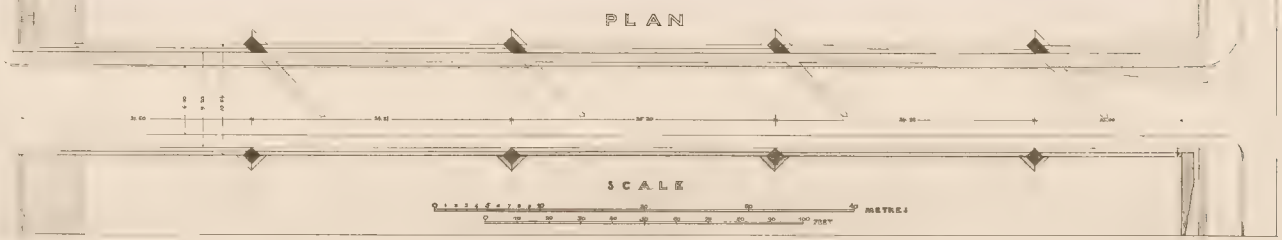
CHALON SUR SAÔNE

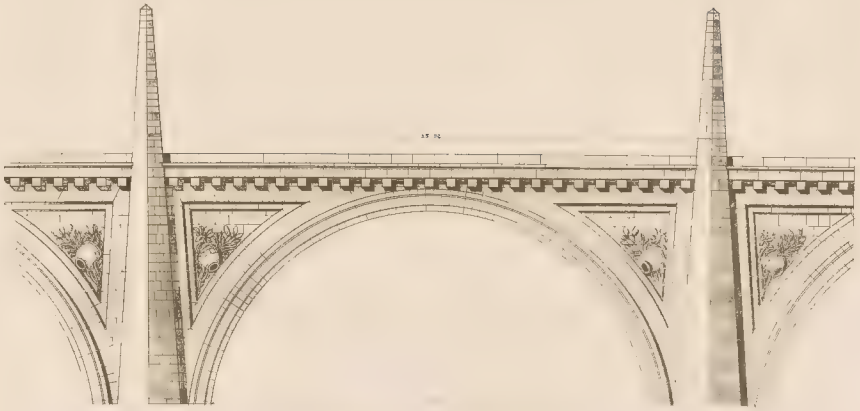
(XVIITH CENT)

PONT S^T LAURENT

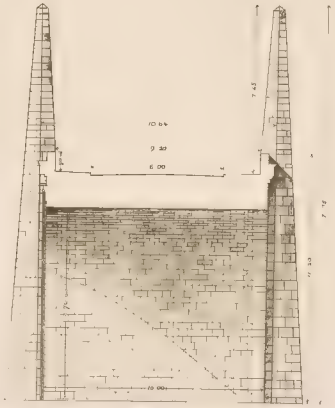


PRINCIPAL ELEVATION (S.W.)





ELEV[illegible]



TRANSVERSE SECTION



PONT S[illegible]

ON THE SAÔNE, AT [illegible]

SCALE.

METRES.

FEET

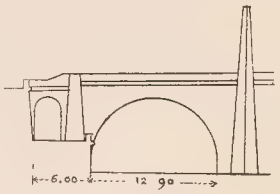


DETAIL OF CORNICE

FEET



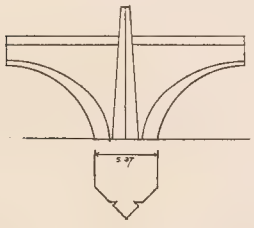
built by Gauthey; as a matter of fact, its present condition is the result of a simple enlargement. The older bridge, which was finished in 1508, even though it had been started a hundred years earlier, was only six meters wide. For many years past the piers of this bridge had been badly shaken by mills that were located upon them, and Gauthey's job was not merely to repair the resulting weaknesses, but to increase the width of the road-bed to about 10 meters[1].



Our Plate XXIX gives the present appearance of the bridge as seen from down-stream. In the first bay, the flattened arch certainly injures the

(1) We might express here the hope that many other structures, such for example as the bridge at Romans (Isère), instead of being disfigured by the addition of iron beams, might have been widened with the same consideration.

general appearance, but this is the result of changes made in the tow-path. The earlier aspect of this first arch is shown in outline in the accompanying sketch, which is as it appears in M. de Dartein's book. It is worth noting here that the up-stream elevation has a different cornice, as well as arches of different proportions. The evidences of the widening are much more apparent on this side. The widened arches are elliptical, and their adjustment to the original arches is brought about by the use of "*cornes de vache*". A study of the accompanying drawing will easily explain the reason for such a difference between the up and down-stream sides. The flood waters of the Saône, which have frequently been so violent as to sweep away the bridges of this region[1], necessitated breaking the force of the current by cut-waters of marked projection. This requirement is fulfilled by the slanting lines, at water level of the arches, of the "*cornes de vache*", which have the same slant in plan as that of the faces of the pyramids at their bases.



Considering the simplicity of the elements that he used, this remains one of Gauthey's most masterly compositions.

(1) The flood of January 18, 1789, carried away the bridges of Louhans and Cuisery. On the same day the centering of the bridge of St. Laurent was destroyed, but the masonry held firm.



The Pont des Chavannes, Châlon, by S. Chamberlain.

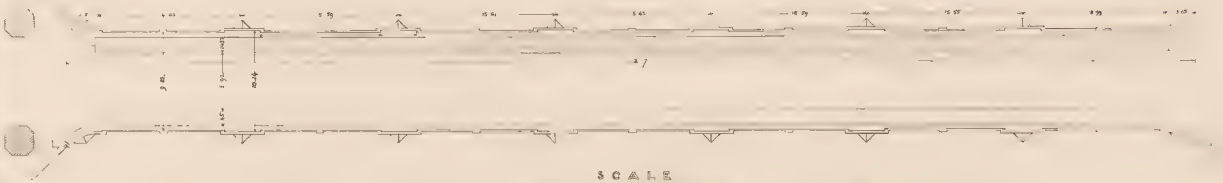
TRÉVOUX SUR SAÔNE

PONT DES CHAVANNES

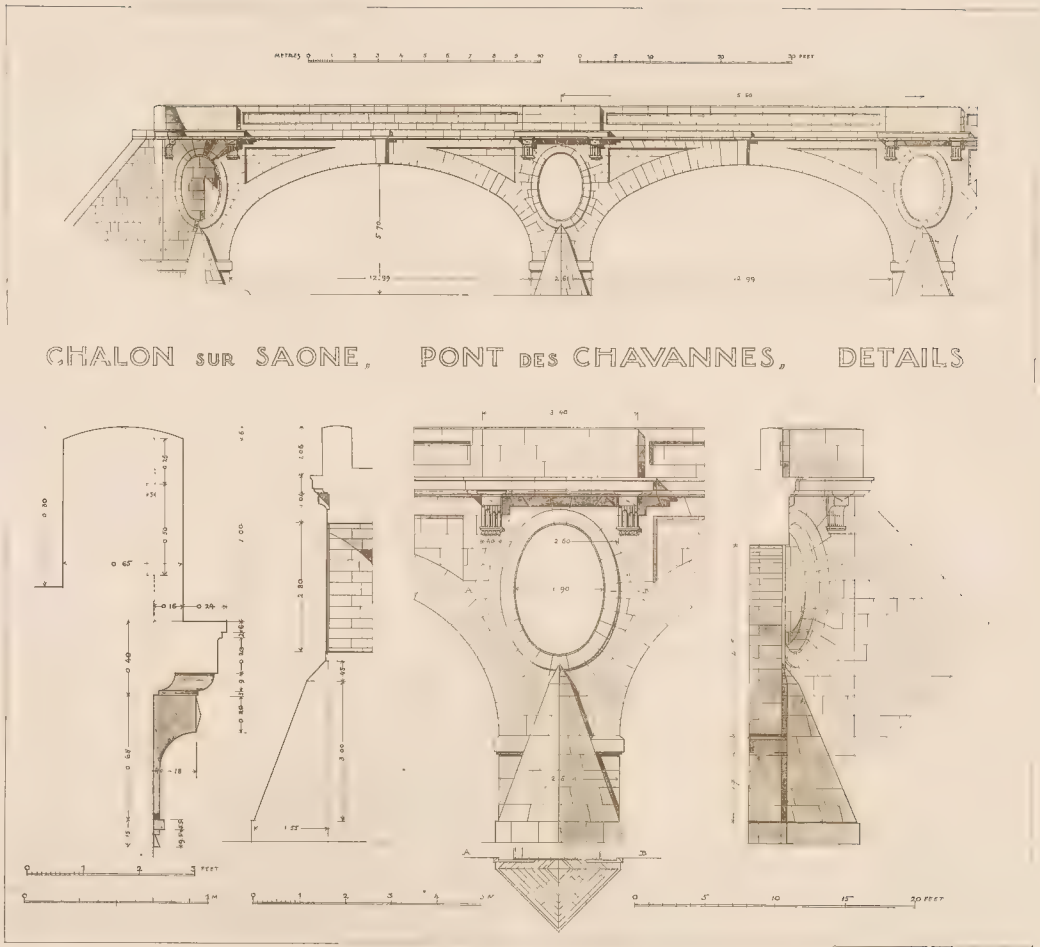


PRINCIPAL ELEVATION

PLAN



SCALE



CHALON SUR SAONE, PONT DES CHAVANNES, DETAILS

BRIDGE OF THE CHAVANNES[1] AT CHALON-SUR-SAONE

The particular conditions that characterised the construction of this bridge sufficiently account for the great difference between its appearance and that of the bridge of St. Laurent. It is only 500 meters beyond the latter, crossing the third branch of the Saône, just outside of the town of Châlon.

Perhaps unique among bridges, it was all but entirely built before the body of water that it was to cross (a discharge canal) had come into existence. Known in its early days as the bridge of the " levée St. Marcel ", none of the usual problems resulting from the depth of water or the needs of navigation affected its construction, which was completed in the five years from 1785 to 1790. In fact the only trouble that its designer, Gauthey, encountered was that the gravel was too dense to permit of driving piles, so that he built his piers on wooden platforms, carried in turn on a sort of grillage three feet in depth.

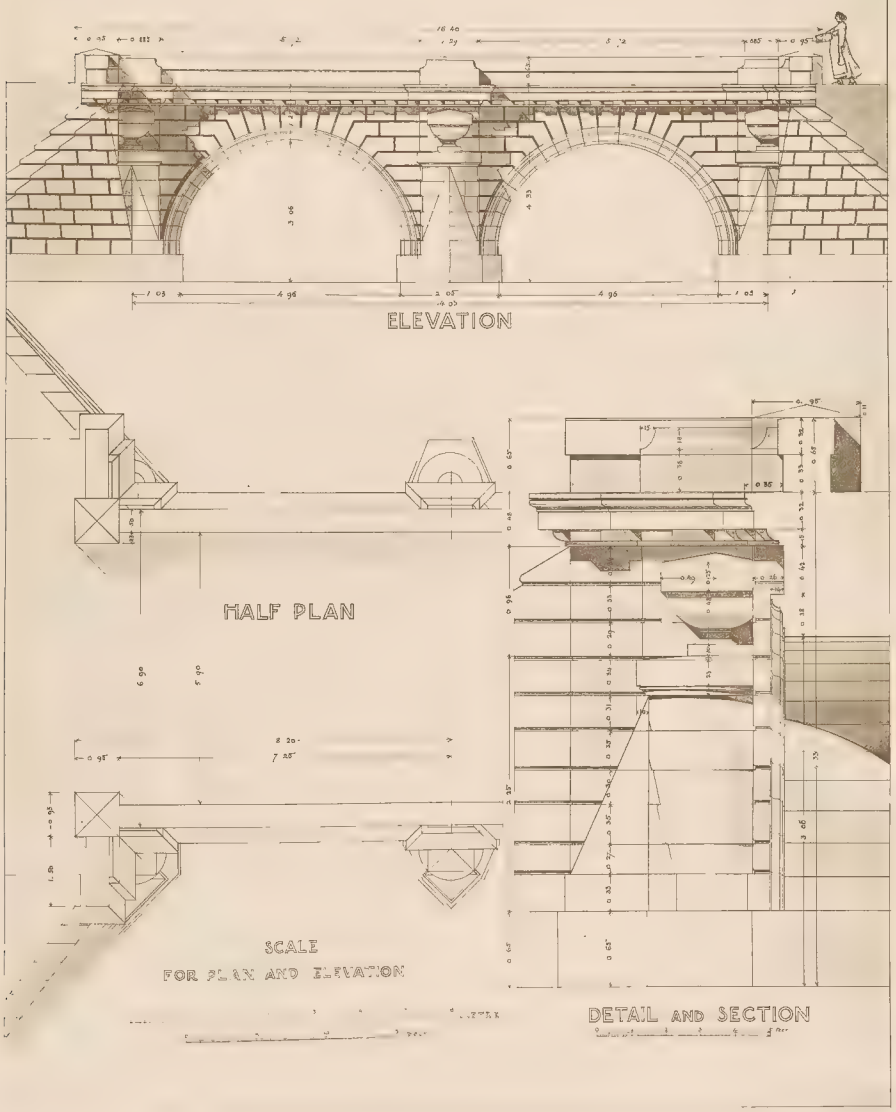
Gauthey showed a nice appreciation of his problem in the skill and simplicity with which he handled the modest lines of this bridge. The chief decorative feature is an oval opening in the center of each pier over the pyramidal break-waters. It would be difficult to exaggerate the quality of movement and the variety of interest that these openings give, in contrast with the lines of the flattened arches on either side. They very pleasantly interrupt with their vertical axes the low line of the road-way, barely 7 meters above the water, that extends for 110 meters between abutments. By recalling in the abutments the decorative motive of the piers, a most happy expedient has been found for giving unity to the entire composition.

(1) This bridge is constantly referred to as Pont *des Echavannes*, although the suburb after which it is named is really the faubourg des Chavannes.

The character of this bridge is so devoid of any suggestion of the monumental, that we find the simplicity with which its mouldings are handled entirely in keeping, and not open to the slight criticism that we made in the case of the bridge of St. Laurent. In fact, our only regret is that, unless the traveler is on the look-out for this bridge, and deliberately leaves the road and descends the bank, he may all too easily miss the distinguished silhouette of this charming structure in its setting among the trees, and cross between the two parapet walls all unaware of the precious monument that lies beneath his feet.



"PONT DE PIERRE," NEAR CHALON

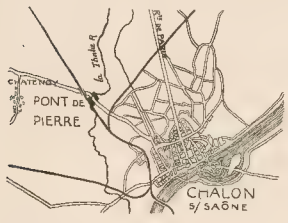


"PONT DE PIERRE" NEAR CHALON-SUR-SAONE

(ON THE ROAD FROM NEVERS)

This is the third of the bridges by Gauthey, in the region near Châlon, that we have selected. The two others cross the Saône to the east of the town, while this one is to be found two kilometers to the west before entering the town, just where the road crosses the little river of the Thalie. It dates from 1766.

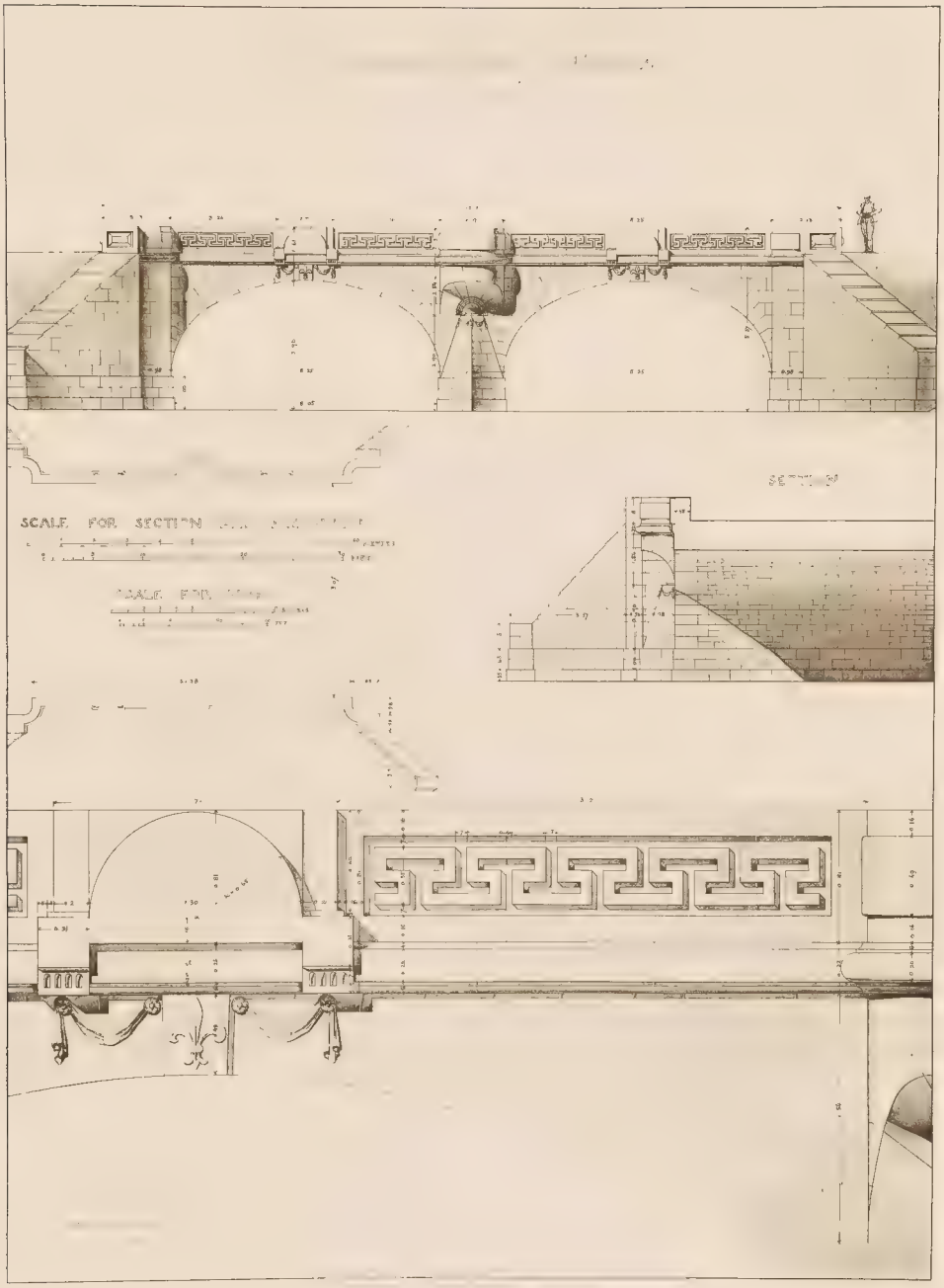
It in no way compares in importance with either the bridge of St. Laurent or that of Les Chavannes, for it is composed of only two arches, five meters apiece in span, separated by a two meter pier. The problem was of so modest, almost insignificant, a nature as to make one wonder how it happened that such serious study and so rounded an architectural solution should have been given to it. But as we have seen elsewhere, this bridge, popularly known as the "Pont de Pierre", was Gauthey's first undertaking after being sent as assistant engineer to his home district, on completing his studies at the *Ecole des Ponts.* It is therefore easy to understand why he should have spent his very best efforts on this simple structure, and there can be no shadow of a doubt that he made a masterpiece of it.



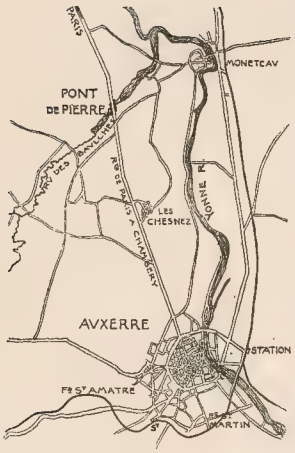
Perhaps we might justly criticize the decoration of this bridge as being too monumental for its location in a country landscape, especially as it is all too easy to cross, as in the case of the Pont des Chavannes, without even being aware of its existence. The parapets give the only indication to the traveler who is approaching that he is nearing anything of architectural interest. These are turned aside at both ends fort a short distance, just where the roadway is reduced, for the bridge, to 5.90 meters.

It we move far enough off the road to secure a good view of the elevation of the bridge, we are struck by its strongly marked architectural lines, and the individual characteristics of Gauthey's work are correspondingly apparent. The arches, the cornice, the piers, the parapets, all express the same spirit that was revealed ten years later in the bridge of St. Laurent, and twenty years later in that of Les Chavannes. The engaged pedestals, in the form of half cylinders, that carry a vase or a sphere, are reminiscent of the pier of the Pont de la Concorde[1]. We have shown the up-stream elevation : on the down-stream side, as the pyramidal cut-waters were not needed, they have been suppressed.

(1) There is an excellent relevé of this bridge in M. de Dartein's work. But it is worth noting that as the result of a mistake by the engraver in the geometrical drawing, the shadows of the vases are indicated as if they were round, whereas actually they are square.


SCALE FOR SECTION

THE STONE BRIDGE NEAR AUXERRE (YONNE)



This little masterpiece is perhaps a mile out of Auxerre, on the road leading from Paris into Savoy. It is not easy either to find or to see, as it spans an unimportant little stream called the *Rû des Baulches*[1], and is largely hidden in underbrush. It is, however, well worth discovery, being a charming piece of design and in perfect condition.

Like the bridge over the Thalie near Châlon-sur-Saône, it is the work of that able and discriminating engineer Gauthey, and is similarly composed of two arches. The work was apparently undertaken in 1781, and finished eight years later by the same builder (Machureau) who had done the bridge at Chalon.

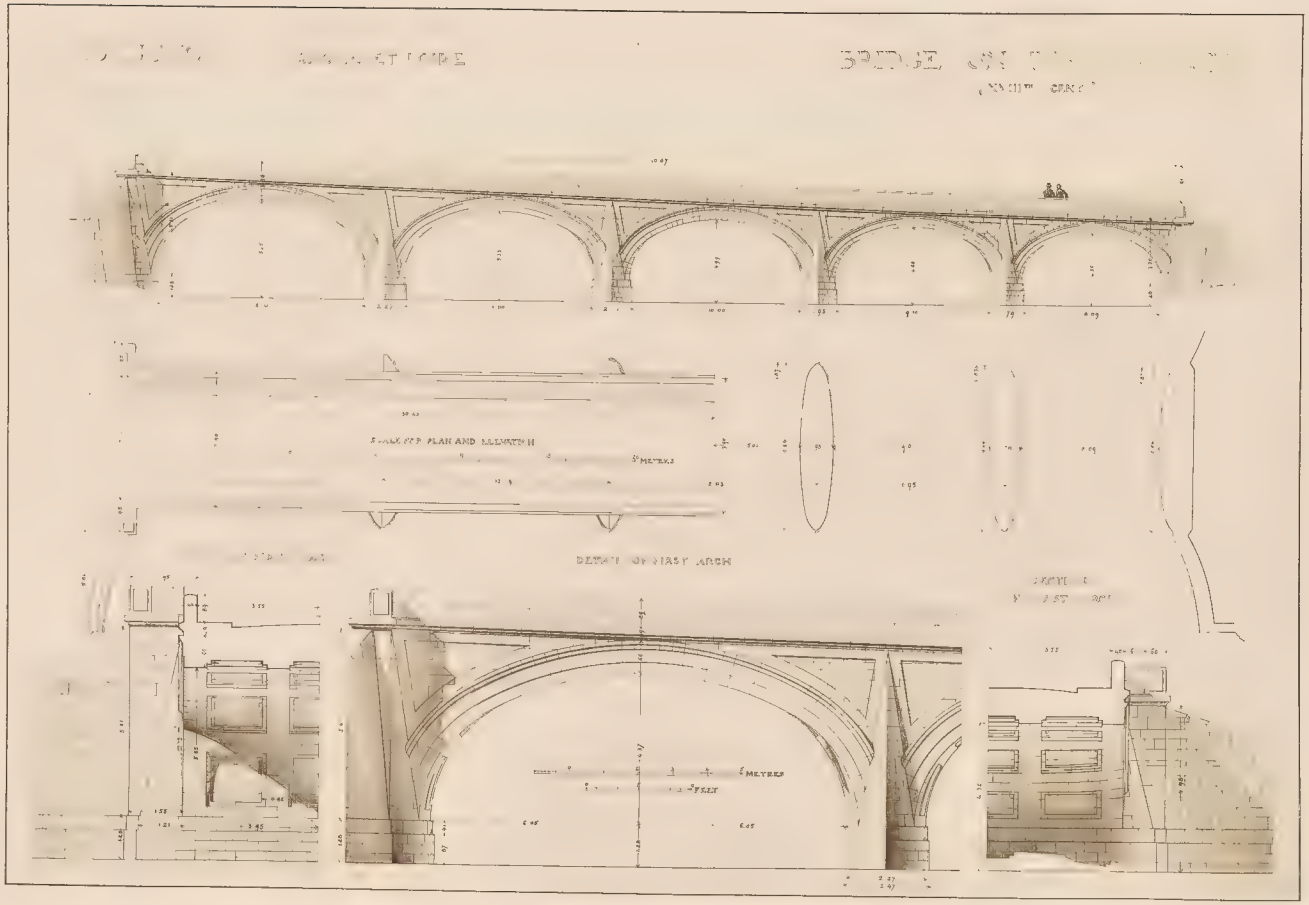
The location would not seem perhaps to call for so handsome a structure, but the result is so good as to disarm criticism from this standpoint, and it is further evident that whatever Gauthey undertook he did as well as it could be done : in fact, this bridge has undoubted charm. The center of interest

(1) The word *Rû* means literally a streamlet or rivulet.

is frankly gathered at the pier between the two arches, which, with its handsome overhanging *trompe* above, and triangular cut-water below, is distinctly effective. The projection of the panels over the keystone, and the scale of the Greek fret of the coping, may be open to criticism in that they tend to distract attention from the main interest in the central pier; but, on the whole, the decorative elements have been used with discrimination; the arches have an agreeable line, and the stone cutting is of the highest order. In other words, we are justified in appreciating the high quality of this bridge as characteristic of Gauthey's constant endeavor to make whatever he set his hand to beautiful as well as useful.



An other bridge at Auxerre, after the sketch by S. Chamberlain.


SCALE OF PLAN AND ELEVATION
METRES
DETAIL OF SKEW ARCH
METRES

BRIDGE ON THE ARROUX AT GUEUGNON (Saône-et-Loire)

Gueugnon is on the Arroux, a tributary of the Loire, which it joins at Digoin. The bridge which crosses it at Gueugnon is an unusual and possibly a unique example of a bridge which slopes entirely in one direction. The slope is fairly marked, as it amounts to 1.90 meters in a little more than 60 meters of length. This continuous slope, of about .03 centimeters to the meter, gives a definite individuality to the bridge, while the simple directness of its architecture still further attracts our attention.

Gauthey designed it in 1783, and it was completed by 1786, thus following close on the heels of his two bridges at Châlon-sur-Saône, which were started respectively in 1776 and 1782. The height of the roadway varies from 7.20 to 5.30 meters above the river, and with a width of 7.10 meters, is carried on five three-centered arches all of whose constituent elements, whether opening, rise, span or thickness of pier, show a progressive reduction from one bank to the other. Thus the openings, which run from 12.10 to 8.10 meters, show a difference of three feet apiece; the small axes of the arches a difference of one foot; the thickness of the piers of half a foot. The spring-line of all the arches lies in the same horizontal plane, thus adding emphasis to the peculiar one-slope character of the bridge.

Although, as we have said, the bridge is distinguished by its unusual nature, it is also noteworthy for the painstaking study devoted to its very least detail. There is certainly no superfluous decoration, yet while the simple architectural elements have been used with dignity, the designer has not hesitated to introduce such motives as the panelling on the underside of the arches merely to please the eye. The thought shown in both the study and execution of the stone cutting throughout the structure shows a most unusual effort; stereotomy requires the utmost precision under the simplest conditions, and in this instance where no stone in any one arch is duplicated in either of its neighbors, the problem of laying out the joints for arch stones and panels was of an exceptionally complex nature.

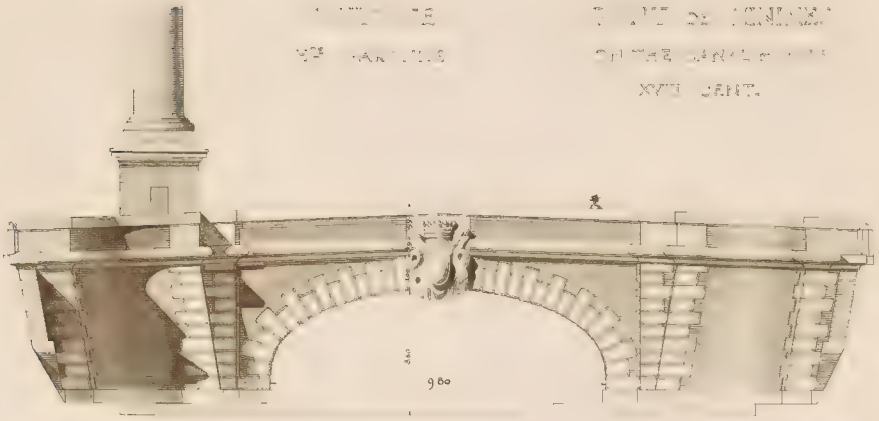
The difficulties were even further enhanced by a peculiarity in the planning of the piers. Their inner faces, instead of being parallel with the direction of the current, are in the form of segments of circles with a radius of over 22 meters. Thus the vaults of the arches, instead of being cylindrical in section, are really formed by two great "*cornes de vache*" which intersect on the longitudinal axis of the bridge. In consequence the arches, when measured on the face of the bridge and at the level of their impost, show an opening .61 centimeters greater than the dimensions given earlier, which were taken on the median line of the bridge.

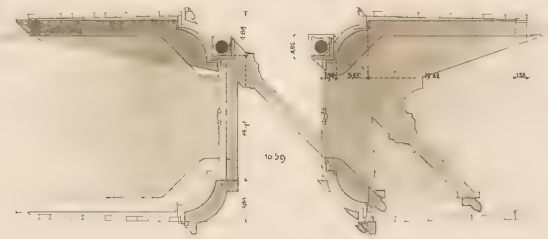
Gauthey does not seem to have been in the least troubled by any of these complications. In fact no technical difficulty seemed insurmountable to him if there were some advantage to be gained in beauty of design. He was certainly the exception among engineers for the care that he gave to the architectural character of his structures and for their great diversity of design.

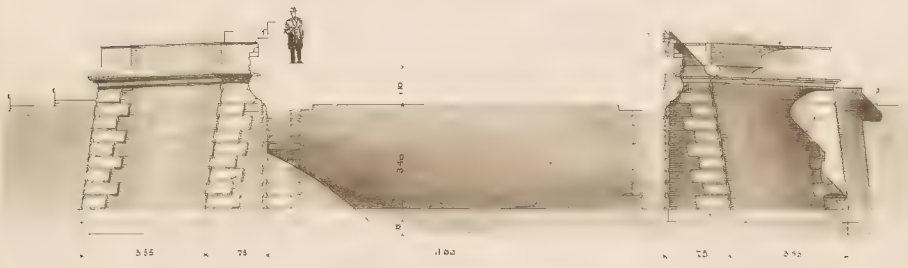
In the practical execution of the bridge at Gueugnon, Gauthey received effective collaboration from the engineer Guillemot. It was he indeed who, before the end of 1782, had drawn up a descriptive estimate of the work, even before Gauthey had completed the final designs; and it was he also who, from the early beginnings in the spring of 1784 up to the time of its completion, directed the general progress of the work.

Circumstances favored the rapid conduct of the work. Not only was it possible to find a rock foundation for the piers, but, by diverting the greater portion of the river to another branch, the work was carried out almost dry. Thus all the piers were practically built at the same time, and except for an unfortunate incident, the bridge would probably have been finished by the end of 1786. Because of some carelessness, or perhaps merely because of the speed with which the work was carried on, it was discovered, when the centering of the lowest arch was removed, that instead of being three-centered like the others it was pointed. This part of the work had to be entirely re-built in consequence, and the bridge was not open for circulation until the end of 1787.

We might call attention to the rather unusual curve of the wing walls. One of these was destroyed during the flood two years after the completion of the bridge, but was immediately rebuilt, since which time the bridge has stood firm under all conditions of wind or weather.









THE PONT DES MINIMES, TOULOUSE

BRIDGE OVER THE CANAL DU MIDI, AT TOULOUSE

This piece of work, known as the *Pont des Minimes,* is composed of but one arch, and that a small one, spans a canal and not a river, and is frankly not a structure of capital importance. It nevertheless has certain qualities that seem to justify its selection. The fact that it was built by the elder Saget is in itself significant, for he and his brother were the authors of the stunning bridge at Lavaur over the Agout, to which we refer elsewhere.

It carries the road to Paris on its single arch of only 9.80 meters' span. The roadway is 18.80 meters wide between parapets, but the width of the approaches is 20.30 meters. Its arch is five-centered, and starts at a height of 80 centimeters above the minor quais on each side. The designs were made in 1760 and the work in large part executed by the contractors Girouard and Sabatier in 1762, the last details being completed at the beginning of 1764, for a total cost of 47.000 francs.

Our attention is attracted by the breadth of handling in plan, by the skill shown in the study of its stone work, the vigor of its mouldings, and the interest in the contrast of materials. In all of these features, the same purpose and capacity are apparent that mark the conception and treatment of surfaces and mass in the fine work at Lavaur. This is perhaps particularly notable in the skill with which the ramps are handled at the entrances, in the striking interest given to the cartouche over the keystone, and the nice harmony of scale between the dimensions of the bridge itself and the mouldings in the string courses. The richness of its warm brick color is particularly harmonious with the architecture of the surrounding city.

One cannot pass over in silence the two brick columns, which, today, complete this little ensemble. They constitute a relatively recent addition, and are due to the work of an architect by the name of Urbain Vitry.

THE BRIDGE OF LAVAUR (TARN) ON THE AGOUT

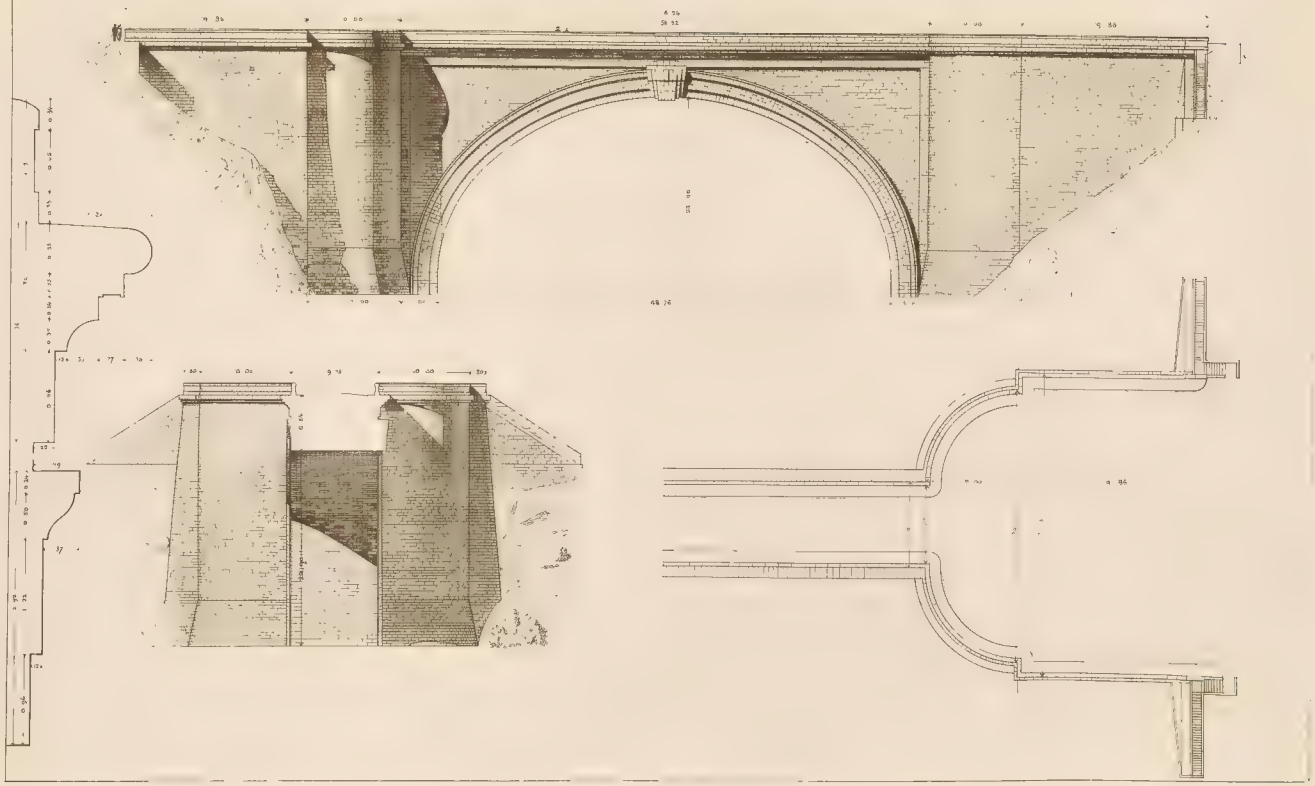
Lavaur is an excellent example of how imposing a result can be achieved from the simplest elements when true art, interpreted through beauty of proportion, is brought to the study of the problem. Doubtless its size alone — never a negligible factor — contributes to the effectiveness of the result. Here is one mighty arch, with a span of 48.75 meters, which carries the road from Lavaur to Castres at a height of 30 meters above the river.

Our drawings show in detail the centers and radii used in the creation of this arch. The bridge proper is 56.50 meters long and 19.50 meters wide, but its approaches, carried on rounded retaining walls, increase the width at either end to 33.30 meters, and the total length to 116 meters.

As was so often the case, red tape, lack of cooperation and of money, combined to make the construction of this bridge a slow and tedious process. Even though the need for such a bridge had been recognized for years before the first discussion of its construction took place, it was twenty-three years from this date (1768) before it was actually in use. The states of Languedoc, eager to do their part toward procuring a structure that by its beauty and dignity should express the importance of the province, had secured satisfactory designs from the two engineers Saget. Although the king promised 60.000 francs towards the cost, that was only a sixth part of what was needed, and actually only a half of this sum was ever contributed. Contractors were naturally shy of offering bids on a work with such inadequate financial backing, so that it was not until 1773 that an understanding was reached with a certain Charvet, who carried on the work until the death of the elder Saget, in 1782. After this the bridge was completed, by Grimaud and Albouy

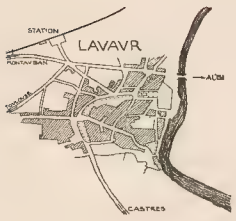
LAVAUR. TARN

PONT SUR L'AGOUT





THE BRIDGE AT LAVAUR



as contractors, under the direction of the younger Saget. It was opened for use in 1791.

The lack of funds referred to above, no doubt explains the modification that was made in the executed work from Saget's original design for the crowning entablature. The resulting cornice, while simple, is effective, even though we may regret the vigorous lines and proportions of the original idea, which harmonized so perfectly with the imposing character of the great arch and its approaches. Indeed we seem to be fully justified in claiming that, if the first plans had been carried out, the bridge of Lavaur would have given us a structure that was the most vigorous expression of this type of public building existant in France. Even as we see it, it is a remarkable evidence of the interest and pride which the old provinces of France showed in such monuments of public utility and art.

BRIDGE ON THE HERS AT MIREPOIX (Ariège)

The Hers is a stream of only secondary importance, but where it is crossed by the bridge of Mirepoix it covers a wide area during periods of flood. This condition explains the long, low lines of the bridge which, while quiet in character, has been handled with breadth and skill.

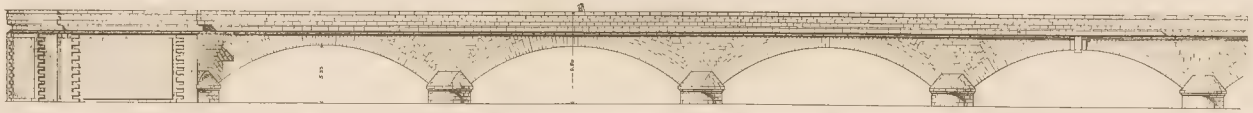
The bridge at Mirepoix is 200 meters long, and is composed of seven arches of equal span, 19.50 meters, between piers 3.90 meters thick. These piers have low cut-waters, both up and down-stream, which project 2.45 meters beyond the face of the bridge, whose width is 8.75 meters.

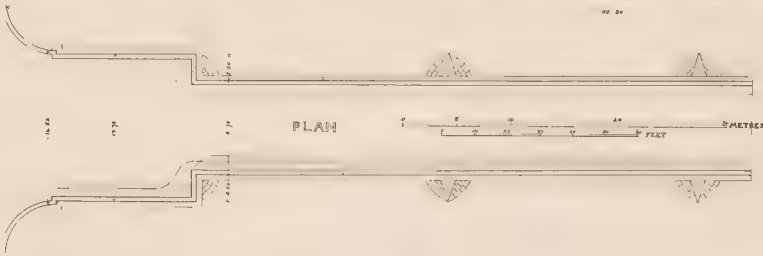
With these characteristics before us, the bridge will acquire its particular individuality as we tell the history of its building. Up to the latter years of the eighteenth century, a wooden bridge provided access, from one side to the other of the Hers, for the many travelers on their way to or from Mirepoix. As early as 1770, this bridge was in such a condition that the engineer Garépuy had been asked to determine what might be done to strengthen it. He decided that the first step was to protect the bridge from the force of the current by break-waters, but no headway was made on these lines because no contractor could be found capable of undertaking the work. In consequence, in 1772, the situation became threatening, and Bertrand Garépuy, the son, was asked to estimate what the necessary repairs would cost, and at the same time to prepare a design and an estimate for a new bridge in stone. Thus at the meeting of the States of Languedoc in December, 1773, it was learned that 15.000 francs would be necessary to repair the old bridge, with an annual upkeep charge of 1.000 francs, while a stone bridge could be built for 360.000 francs.

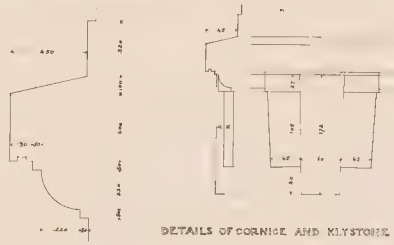
MIREPOIX ARIEGE

BRIDGE ON THE LERS
(XVIIITH CENT)

HALF ELEVATION

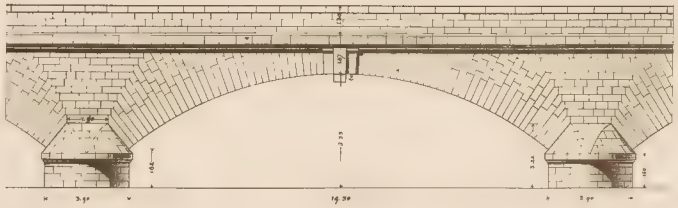




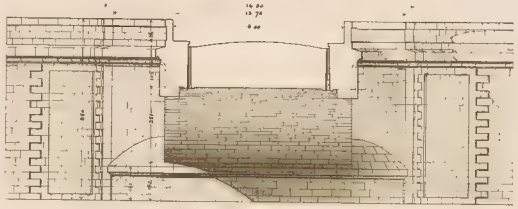


DETAILS OF CORNICE AND KEYSTONE

CENTRAL ARCH



SECTION





THE BRIDGE AT MIREPOIX

There were, however, repeated delays, so that it was only in 1775 that Bertrand Garépuy showed a model of his proposed bridge, as well as that of his remarkable design for the bridge at Gignac. The contract was finally awarded in 1776 to a man named Estève, and at the exact price of the estimate made in 1773.

The bridge was almost twenty years in the building. Poor workmanship or bad centering in some of the arches resulted in insufficient roem for the keystones, which, with an entire disregard of common sense, were pounded into place, with the result that the contract had to be cancelled and these arches done over.

The resulting bridge, allowing for its slight elevation above the level of the river, is distinctly successful, suiting both its setting and the particular conditions that it was called upon to meet. The versatility of its designer is well shown by contrasting its quiet lines with the striking design of the bridge at Gignac.

BRIDGE ON THE MOSSON
NEAR VILLENEUVE-LES-MAGUELONNE (Hérault)

As we study the drawing of this fine structure, we are conscious of certain points of resemblance, a kind of family likeness, with Gauthey's charming bridges on the Thalie and near Auxerre, for as is the case with both of the others and also with the Roman bridge of St. Chamas, the bridge of Villeneuve-les-Maguelonne lies outside of any settlement. It is many a long year since the town of Maguelonne, the ancient colony of *Magalona*, disappeared from the narrow strip of land that separates the Gulf of Lion from the marshes of the Arnel. It was first destroyed in the VIII[th] century during the Saracenic occupation, and, except for its church of St. Pierre, completely obliterated during Louis XIII's reign, because it had allied itself with the Calvinist party.

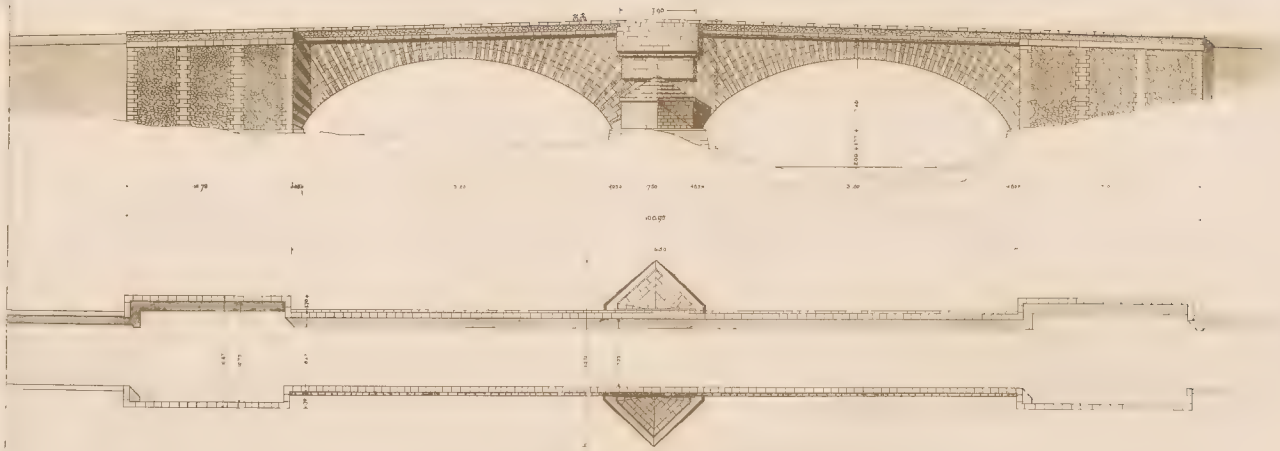
In order to find our bridge on leaving Montpellier, we should follow the road to Béziers for two and a half kilometers before turning off to the left on the road to Cette for three kilometers more, at which point the bridge carries us over the little coastal stream of the Mosson. We recognise at once that though it is composed of only two arches, it is considerably more of a structure than either of those bridges with which we have compared it. It is 119 meters in length, and its two arches, each with a span of 31.80 meters, are separated by a vigorous pier which is 9.20 meters thick.

Floods of unusual violence in the year 1766 had overthrown the bridge on the Mosson, as well as several others in the Montpellier region. In consequence

VILLENEUVE LÈS MAGUELONNE (HÉRAULT)

PONT SUR LA MOSS[illegible]

(XVIII[e] SIÈNT)



SCALE FOR PLAN AND ELEVATION





the first steps were taken at this time (just when Gabriel was building the Petit Trianon at Versailles) to secure designs for a new bridge. Giral, the director of public works for the diocese, made the design, and the contract was awarded to an individual named Chrétien. Within two years he had to give up his job, being succeeded by Nogaret, under whom the work was finished in 1778. The bridge proved a costly experiment : the original contract was awarded at so low a figure that the actual cost ran three times over the original appropriation[1], resulting in endless difficulties and a tedious lawsuit.

While the drawings give the lines of the bridge clearly enough, certain characteristics are of sufficient interest to call for comment. The fact that the volume of water carried by the Mosson showed wide variations at different times of the year, determined the use of three-centered arches, in order that the free-way might be relatively uniform under all conditions. At ordinary times the river flows under only one of the two arches, the other being intended to take care of the excess in time of flood. But the three-centered arch is not used in its entirety. It its abbreviated on either side so that the curve falls perpendicular to the sloping surface forming the top of the lower member of the cut-water. In this manner no use is made of the last portion of the arch which, because of its short diameter, has less solidity. This is probably a unique example of only the *arc* of a three-centered arch being used as the generative curve of a bridge arch.

Another unusual feature is the emphasis given to the arch stones which, from an architectural standpoint, results in an appearance of commanding solidity. This effect is enhanced by the treatment of the raised surface of these arch stones, which are covered alternately by an incised pattern of sufficient depth to give a texture contrasting most effectively with the plain surface of the intermediate stones.

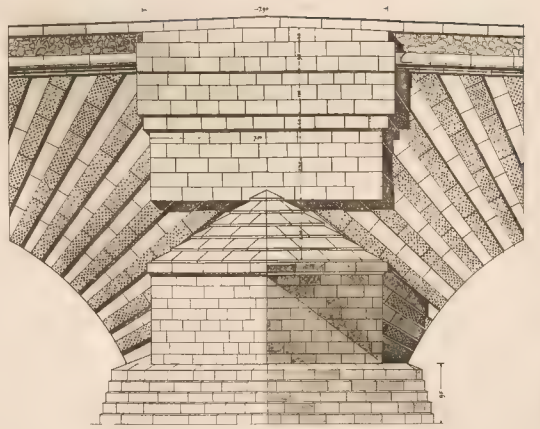
It seems indeed that Giral, — after whom one of the little squares which open into the handsome promenade of Peyrou at Montpellier is named, — treated his problem in design more as an architect than as an engineer. The importance given to the central pier, the pronounced projection that marks the crowning element of the cut-water and the emphasis given to the arch stones, all indicate the hand of the architect. One might be surprised at the apparently casual manner in which the cut-water is connected with the salient motive

(1) With a first appropriation of 80.000 francs, the cost amounted to 225.000.

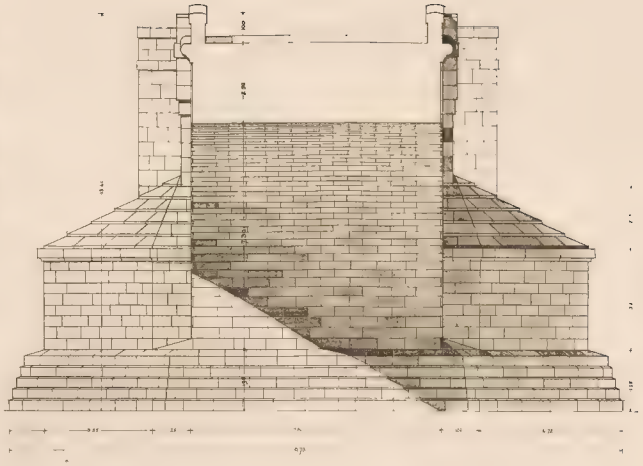
that dominates it; one might even be inclined to decide that it was very inadequately studied if it were not apparent that the triangular spaces between the cut-water and its crowning member further emphasized the intention of the designer to thus add to the character of the arch stones.

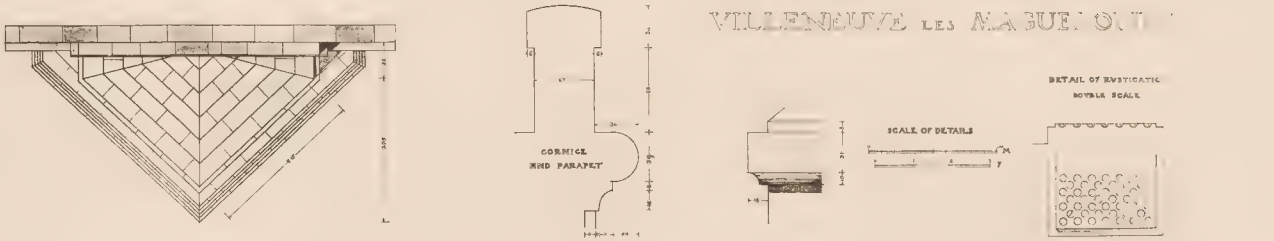
The same decorative effect is to be found in the arcade of the Peyrou, mentioned above, and in another bridge of Giral's at Montferrier. It was later recalled in the bridge at Gignac on the Hérault.

It is interesting to note how the marked simplicity of the parapets, as well as the rest of the stone work in the abutments, emphasises the richness of the handling of the arches : the contrast is so marked as to be almost brutal. But we are inclined to think that, in creating this effect, the designer is achieving exactly what he wanted by drawing attention to this particular point of interest. A different impression is expressed by Mr. de Dartein, who looks upon this striking contrast as a result of the economies practised in consequence of the greatly increased cost of the bridge. Whichever is the correct interpretation of the facts before us, we can at least agree that the bridge is a most vigorous and striking piece of design.



ELEVATION AND PLAN





DETAILS OF CENTRAL PIER

VILLENEUVE LES MAGUELONE

CORNICE AND PARAPET

SCALE OF DETAILS

DETAIL OF EXSTICATIC DOUBLE SCALE

THE BRIDGE AT PONT SAINTE-MAXENCE ON THE OISE

If we consider it from the point of view of the engineer alone, the bridge across the Oise at Pont Sainte-Maxence should be considered Perronet's[1] masterpiece. Those of more artistic leanings would probably prefer the Pont de la Concorde at Paris, while as for Perronet himself, it is more than likely that his choice would have favored the bridge across the Meurthe at Saint-Dié, for which he undoubtedly supplied the original idea[2]. We have given the curious outline of this latter bridge in our diagrams. It shows how this skilful engineer, going beyond what was reasonable in his persistent effort to secure a free-way that should be constant under all conditions by the use of arches that were practically flat, succeeded after all in creating a type of bridge that was much more unusual in appearance than it was agreeable.

Considered as to the relation between its free-way and its total span, the bridge at Pont Sainte-Maxence has never been surpassed probably, nor even equalled. In a total length of 79 meters, carried by three arches of 23.40 meters each, the free-way is actually in excess of 70 meters. To achieve this result, the piers (2.92 meters in thickness) have not only been reduced below what was considered the irreducible minimum, but have furthermore been so lightened in actual bulk by the elimination of stonework in the center, that they give the general appearance of coupled columns. In order to gain some idea of the daring required for such an innovation, it may be sufficient to cite that Perronet himself gave as a rule-of-thumb method, for computing the thickness of piers, the doubling of the thickness of the arch at its crown, plus a third of this result. He followed this formula for the bridge at Neuilly, where

(1) J. Rodolphe Perronet was born at Suresnes in 1708, and died in 1794. He was a member of the Académie des Sciences and of the Académie d'Architecture. His best known bridges are those of La Concorde at Paris, of Neuilly, of Pont Sainte-Maxence, of Pesmes on the Oignon, of Nemours on the Loing, and of Fouchard on the Thouet.

(2) See p. 17. This bridge was designed by Lecreux (1785).

the thickness of the arches measures 1.62 meters at their crown, and the width of the piers is 4.20 meters. Following the same procedure for the bridge at Pont Sainte-Maxence, where the corresponding thickness of the vault is 1.44 meters, we should have a width of 3.84 meters for the piers, which are actually 2.92 meters.

To aid Perronet in living up to the courage of his convictions, was his own scientific knowledge as a master builder supplemented by the conscientious competence of his assistant Demoustier, who personally directed the work, as indeed he did at the Pont de la Concorde as well. He was further assisted by the quality of the materials at his disposal : Perronet found within hand's reach a stone of most unusual qualities, with whose properties of resistance he was so familiar that he did not hesitate to submit it, in both his piers and abutments, to an unprecedented pressure. It was, however, the thinness of the piers much more than their central openings that might have given cause for anxiety, though both of the two portions of the pier rested on a specially designed bed in three layers, which distributed the load, below water level, over an area measuring 5.85 meters in width by 18.50 meters in length. Nevertheless, when there was question a few years later of building the Pont de la Concorde with piers of an identical design[1], it was felt, in spite of the example offered at Pont Sainte-Maxence, that this arrangement did not show a sufficient assurance of security, so the design was changed and no other bridge has since followed the example of the one under discussion.

In addition to the remarkable departure from accepted methods shown in the piers of this bridge, the use of segments of circles of considerable radius, in place of three-centered curves for the arches, was also looked upon as an innovation. It is indeed true that there had been no other examples among French bridges up to this time, but it is only fair to remind our readers that the *Ponte Vecchio* at Florence, which is still picturesquely crowded with houses, had been built many years previously with similar arch curves of an even bolder design[2].

The general appearance of the bridge at Pont Sainte-Maxence is handsome, probably thanks to the treatment of the approaches and the handling of certain details, and in spite of the rigid or abrupt transition from the vertical lines of the piers to the almost horizontal lines of the flattened arches. The obelisks that flank the entrances to the bridge are evident from an appreciable distance; it would almost seem as if an attempt had been made to accentuate their impression by the long straight lines that border the road on both approaching and leaving the bridge.

(1) These two bridges were to all intents and purposes studied simultaneously : a model of the Pont de la Concorde was shown to the King in 1772, and the model of Pont Sainte-Maxence belongs to the same year.

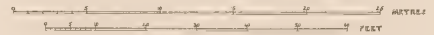
(2) The arch of this bridge has an opening of 26.30 meters, with a rise of only 3.50 meters.

(XVIIITH CENT)

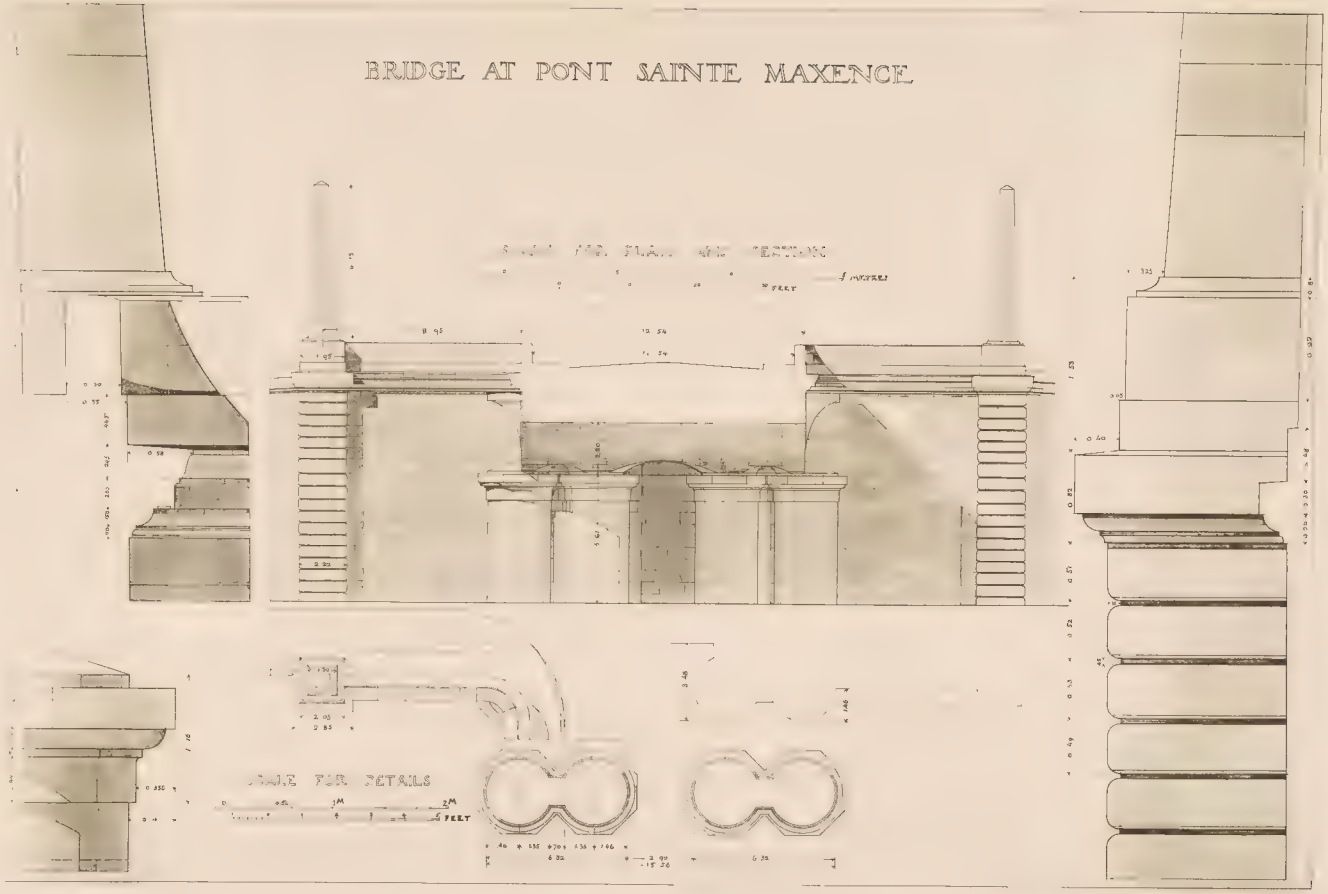


BRIDGE ON THE OISE AT PONT-SAINTE-MAXENCE

SCALE FOR ELEVATION AND PLAN



BRIDGE AT PONT SAINTE MAXENCE



In spite of the technical difficulties in the execution of such a bridge, no incident of interest occurred throughout the process. Plans had been made as early as 1758 to replace the utterly dilapidated older bridge by a modern structure. Beyond a few preparatory borings, however, progress was slow, and it was not until ten years later that Perronet was asked to prepare a design for the new bridge. He was occupied with this problem during the construction of the bridge of Neuilly, and in 1771 presented his formal drawings, followed a year later by a model at a scale of .07 to the meter from which the executed work varies only in regard to the cornice. The work was let in March, 1773, to a contractor named Pedemay, a man much esteemed by Perronet, who was perhaps in some guise a former student of the Ecole des Ponts. The work had evidently been placed in this man's hands even before any definite contract was let, for he had declared himself willing beforehand to accept any conditions that the engineers might establish. Pedemay dying in 1779, the work was undertaken first by Léonard Legrand, and in the following year by Etienne Pécheux. Between them, except for an interruption from 1777 to 1779, the work progressed steadily until the bridge was opened to circulation in 1786.

As was true in the case of the Pont de la Concorde, Perronet gave constant personal supervision to the work, and though he does not seem to have changed any of the main characteristics, he gave special attention to the study of the cornice which, in his early designs, amounted to nothing more than a string course in the form of a half-round. With the addition of 16 centimeters to the distance between the crown of the arches and the top of the parapet walls, it was possible to introduce the moulded cornice that now crowns the work. Even though these mouldings seem perfectly in place, there is some question whether the general appearance of the bridge has not suffered in consequence of this change. The resulting mass of stonework above the opening of the arches seems to call attention to the lightness of the piers, and makes them appear almost too slight to carry such a load. This defect, if it is one, is of course much less apparent in perspective than in the geometrical drawings.

PONT DE LA CONCORDE AT PARIS

This bridge, which is noteworthy both because of its architectural appearance and because of certain unusual constructional features, is the last work of the great engineer Perronet (1708-1794). Perronet was the first director of the Ecole des Ponts, founded by Trudaine in 1747, and this bridge would undoubtedly have been considered his masterpiece — at least from an engineer's point of view — if he had not been constrained to make certain changes in the course of the construction which materially modified its original character. It was planned to be even lighter than the bridge at Pont Ste. Maxence; yet, modified as it is, Mr. de Prony(1), writing in 1829, refers to its central arch as "the most daring construction that has been so far executed".

This kind of daring does not particularly recommend itself to us. It savors of a "tour de force", and in spite of the skill and knowledge with which it has been handled, we would prefer to see stone used within the reasonable limits of the material rather than forced to serve a purpose which seems beyond its nature. We say this while at the same time admitting that excessive daring of this nature seems to have been characteristic of the period, for Soufflot tried to carry the dome of the Pantheon on such light supports that piers had to be practically created after the work was executed.

Perronet's dominant purpose, as he has himself expressed it, in designing a bridge, was to provide adequately for the free flowing of the current. It appears that he had been much impressed by the construction of a bridge in China, at Loyang, where the piers were simple vertical walls that carried great

(1) Note on Perronet's life, for the Institut.



THE PONT DE LA CONCORDE AT PARIS

flat slabs of stone in the nature of lintels. Being unable to find any stone able to resist the deflection under such conditions, Perronet aimed at so reducing the curve of his arches that they should become nothing more than flat vaults. Under such conditions the piers would have little to do, the entire thrust being actually transferred to the abutments. Viewed from this standpoint, the Pont de la Concorde is sufficiently remarkable even at is stands.

It is well to remember that while the Place de la Concorde, by Gabriel, took form during the years from 1753 to 1763, the bridge of the same name was not executed until a generation later (1787-1791). This is true even though Perronet began studying his design as soon as the work on the Place was far enough advanced to indicate its nature; in fact, his idea, represented in a



model, was approved by Louis XV in 1772. Fifteen long years passed before the contract was finally awarded to François Prevost, a contractor of the Ponts et Chaussées, for 2.993.000 francs. By this time Perronet was seventy-eight years old and far from well. He asked that Desmoutiers, who had helped him in carrying out the work at Pont Ste. Maxence, and de Chézy, should be assigned as his assistants, and, the better to supervise the work, established himself in a little pavilion at the end of the bridge, next the Place, where the architect Moreau[1] had lived previously. From here he saw the first stone set in place on August 11, 1788.

During the period from the letting of the contract to the laying of the first stone, complaint was made, either by envious engineers or anxious contractors, as to the security of the proposed work, with the result that Mr. de Breteuil, the minister, required either that the piers be increased in thickness, or that they be made of one solid construction from the up to the down-stream side, without the intermediate opening shown in the design. Perronet pointed out that this would cut out one of the elements essential to the beauty of his bridge, and

(1) It was here that Perronet died at the age of eighty-six.

that had been roundly approved at Pont Ste-Maxence; but his plea was vain, for though the piers were not thickened, they were certainly built without the cherished opening — this, to our thinking. without injuring the appearance of the bridge.

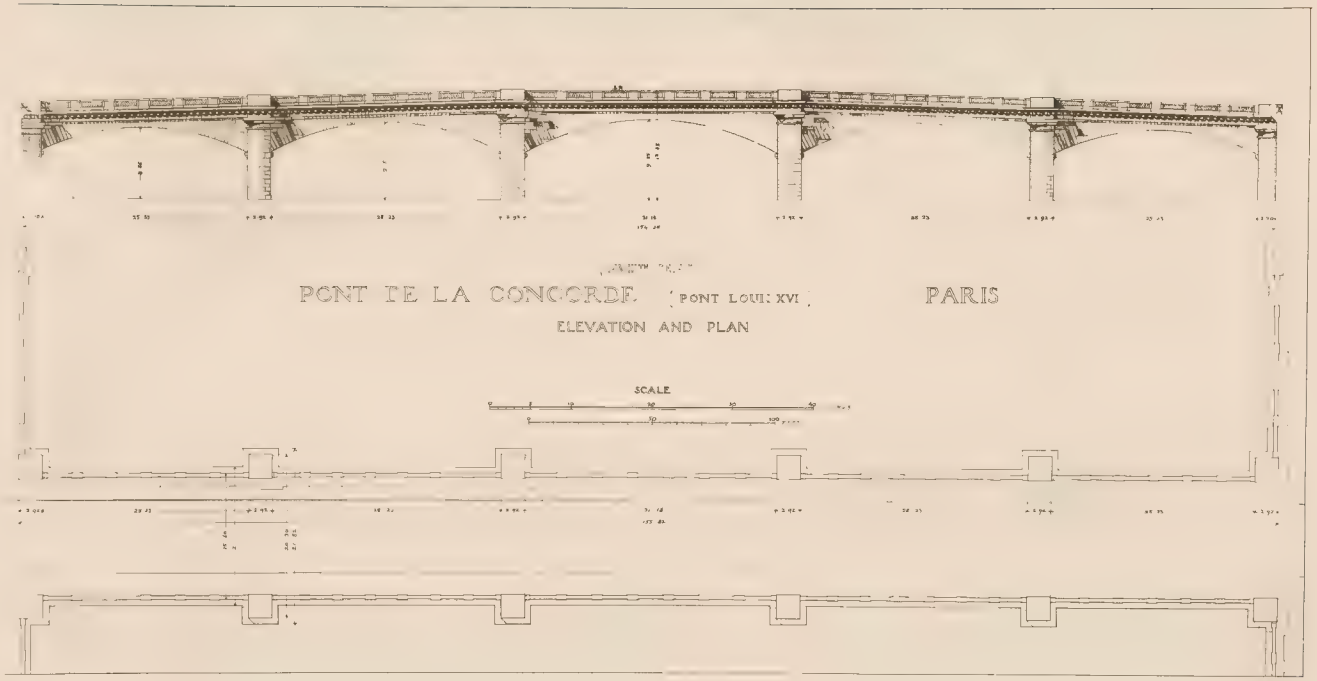
Another change was forced upon Perronet at the same time; namely, an increase of a meter in the rise of the arches, on the plea that the original design did not leave sufficient room for navigation. This again was contrary to one of Perronet's most cherished beliefs, for, as we have seen, a construction approaching, in appearance at least, that of the bridge in China was his goal.

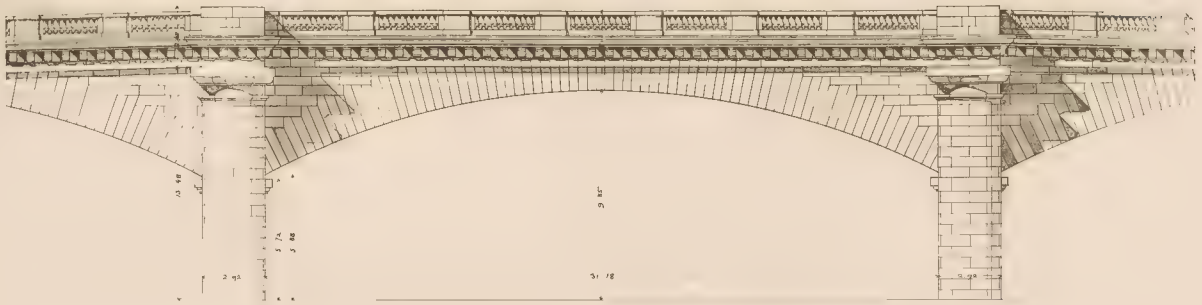
In spite of these enforced changes, which to a man of Perronet's age and reputation must have been particularly humiliating, the work progressed rapidly. This is the more remarkable when we realise that it was being built during the up-heaval of the Revolution, and is indeed a further tribute to the energy, enterprise and devotion of the aged engineer who hoped to see in the Pont de la Concorde the crowning achievement of a distinguished career. Living, as we have seen, in the midst of the actual work, he not only assured by his presence the correct selection and placing of every block of stone, but when in 1790 lack of funds threatened interruption at a vital moment in the building of the arches, he was able by approaching Bailly, who represented the city of Paris, to secure the continuation and the practical completion of the work, so that the bridge was opened to traffic by the end of the following year.

It is interesting to note that at this time, and when there was question of filling in the ditches surrounding the Place de la Concorde, a certain citizen Grosbert, director of the arsenal of Meulan, proposed other modifications to the Place which, if carried out then, would have given conditions very similar to those existing at the present time. In place of the statue of Louis XV he proposed that an obelisk be erected with a fountain on each side; and together with the filling in of the ditches he urged that the eight great pedestals be crowned by seated statues.

As to the physical characteristics of the bridge, they do not appear to have varied fundamentally from the original scheme in spite of the changes noted above. Of the five arches the central one his level, the road-way sloping thence to the two banks with a grade of about 2 1/2 centimeters to the meter. This slope of the bridge is nicely compensated in the diminishing spans of the arches. These vary from 25.35 meters in opening next to the shore, to 28.25 meters next the center, which in turn is 31.20 meters. The rise originally planned for these arches varied from 1.98 to 2.98 meters, but was increased to from 2.77 to 3.97.

The piers, which have a uniform width of 2.92 meters, are carried on


PONT DE LA CONCORDE (PONT LOUIS XVI) PARIS
ELEVATION AND PLAN
SCALE



ELEVATION OF CENTRAL ARCH

DETAIL

METRES

FEET

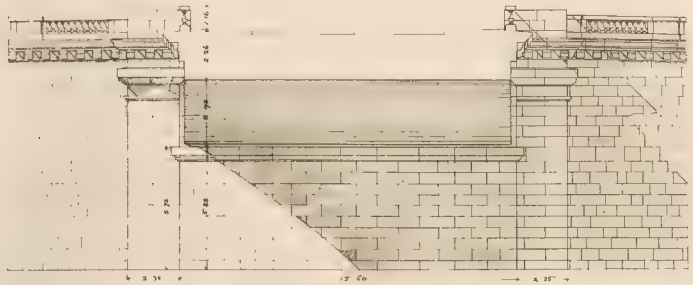
PONT DE LA CONCORDE PARIS

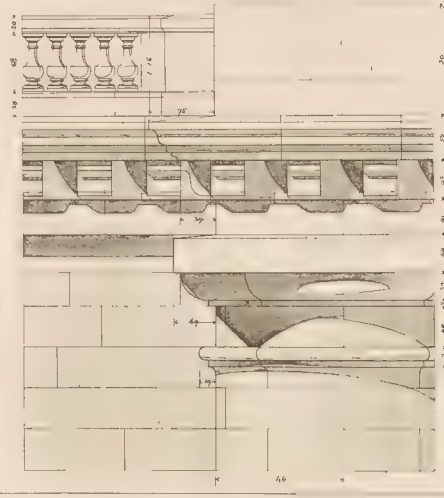
SCALE

METRES

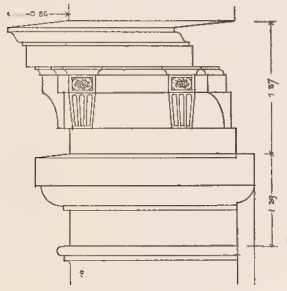
FEET

SECTION ON FIRST ARCH





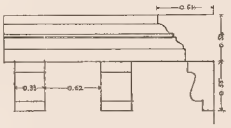
wooden platforms two meters below the level of the water. These distribute their loads over an appreciably larger area with the help of successive layers of foundations of a depth of two meters. The overall width of the bridge is 15.10 meters, the face of the balustrade extending 25 centimeters beyond that of the walls.



First scheme of cornice
(after M. de Dartein)

In such a detail as the cornice, much more thorough going changes were made than appear in the structure. As shown in the model of 1772[1], the entablature his handled with brackets of a style corresponding to that already established by Gabriel, prematurely Louis XVI in character. This was found to add so considerably to the weight carried by the arches, that it was abandoned and consistently simplified and restricted, until it appears, if anything, somewhat over-reduced, although the general effect bears ample evidence of study by a master hand.

A monograph of the Pont de la Concorde by Mr. de Dartein calls attention to a general similarity in character between the cornice of the Concorde and that of the Roman bridge of Rimini. Whe show a sketch of this cornice for purpose of comparison.



Cornice of the bridge at Rimini

The Pont de la Concorde shows the first use on a bridge, in France, of a balustrade for a parapet, here again indicating the nice appreciation of the designer for the character of Gabriel's work in the Place de la Concorde.

We cannot pass without comment a feature of the original design which was never realised; that is, the crowning motive of the great rectangular pedestals over the engaged columns. As first planned, these were to have been open-work bronze pyramids, of a truly interesting design that would have given somewhat the same effect, though still more monumental, as those of Gauthey's fine bridge at Chalon-sur-Saône. As money was lacking for this first and really fine idea, successive suggestions for smaller pyramids, tripods and statues all failed of fulfilment, either because of lack of funds, disturbed conditions, or, with the rapidly succeeding governments, because no one was ready to agree as to which of the nation's heroes were entitled to be distinguished by having their statues placed upon the bridge. Finally, agreement was reached by choosing for this distinction men whose services belonged to a time far enough removed from the present not to arouse controversy, and from 1816 to 1828 these statues were in the making. Put in place in the latter year,

(1) This is still to be seen at the Ecole des Ponts.

they failed to give satisfaction, and, in 1837, were moved to the great entrance court at Versailles, where they are far from adding any element of interest.

As we become accustomed to the bridge without these crowning features, it certainly seems wise not to make any change at this late date; but we are inclined to agree with Mr. de Dartein that, if statues were to be used, it would have been well to study the bridge of St. Angelo at Rome; and are further of the opinion that the best result would have been obtained in completing the bridge according to Perronet's original design. His judgment and skill have been so amply justified by the qualities of the work that stands before us that we may have entire confidence in the wisdom of his conception in this respect as well.

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ERRATA

PAGES

3 8th line from bottom of page, *read* "Perhaps *there is* nothing".

13 1st line under map, *read* "Modern bridges such as the works of Perronet, if we except the old bridges of Paris, the Pont-Neuf".

15 Foot-note. *Read* "All the *dimensions* are given here in meters. *It should be noted* that the French meter equals *3 ft. 3 3/8 inches* and 10 meters *equal 32 ft. 9 3/8 inches.* The *length* of the foot is exactly *.304794 meter*".

18 Top line *read*, "*St. Peter's* Bridge".

21 Bottom line *read*, "to exist *alongside*".

30 Last paragraph, 5th line, *read* "This bridge, *the Pont Julien*, of which".

30 Last paragraph, 10th line, *read* "which *there borders* the Coulon".

31 2nd line from top, *read* "*coastal* stream".

36 Top line *read*, "against the *Reformation*".

55 2nd paragraph, 4th line from bottom, *read* "It is the one to the *West*".

60 Last paragraph, 2nd line, *read* "little remains that *is* especially".

78 2nd paragraph, 9th line, *read* "only to *be* thrown into the Seine".

79 2nd paragraph, 7th line, *read* "will recall that *the* arches".

96 1st line *read*, "in 1782 as *a* continuation of it".

96 2nd paragraph, 4th line, *read* "it *would* be".

102 1st d° 6th d° d° "These are turned aside at both ends *for*".

102 2nd d° 1st d° d° "*If* we were".

111 2nd d° 2nd d° d° "resulted in insufficient *room*".

113 1st d° 11th d° d° "actual cost ran *to* three times the original".

113 2nd d° 8th d° d° "It *is* abbreviated".

114 3nd d° 2nd d° d° "*emphasizes* the richness".

120 Last d° 3nd d° d° "Of the five arches the central one *is* level".

120 Last d° last d° d° "was increased from 2.77 to 3.97".

121 2nd d° 4th d° d° "the entablature *is* handled".

121 3nd d° 4th d° d° "*We* show a sketch".

DANIEL JACOMET & Cie
68-70, Rue Erlanger
PARIS (xvie)

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